MACHINERY.

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THE MANUFACTURE OF AGRICULTURAL MACHINERY,

AS CARRIED ON BY THE WALTER A. WOOD MOWING AND REAPING MACHINE COMPANY OF HOOSICK FALLS, NEW YORK.

JOSEPH V. WOODWORTH.

Walter A. Wood.

THE attractive and prosperous village of Hoosick Falls, N. Y., the home of the Walter A. Wood Mowing & Reaping Machine Co., is situated 182 miles from New York City, near the Vermont State Line and only 16 miles from the Massachusetts line. It lies in the beautiful Hoosick Valley, noted for its picturesque scenery, and famous, as well, from an historical point of view. Long before the white man settled in America the Hoosick Valley was the warpath and formed part of the "eastern trail" of the Iroquois and Algonquin tribes, over which they marched in their series of wars of extermination. The valley is also historical as the warpath of the French and Indians, through which they marched on the villages of New England in the earlier French and Indian wars.

The word Hoosick is of aboriginal derivation and the theory is that it is formed from the Indian words Hoo, meaning owl, and sac, meaning valley—"owl valley" or "valley of the owl." The district of Hoosick was formed March 24th, 1772, and five years later was fought within the town limits one of the most decisive battles of the Revolution, the battle of Bennington. It is interesting to note that this battle occurred but a short distance from Hoosick Falls, near Walloomsac River and should properly be called the battle of Walloomsac, as it was fought entirely within the town limits and not at Bennington at all.

Of more importance to the general reader, however, are the claims to fame of the modern Hoosick Falls, through the development of its great agricultural machine works. Nearly fifty years ago Walter A. Wood, then a poor man with a limited education, but endowed with energy, courage and genius, turned his attention to the invention and manufacture of harvesting machinery, and started, in a very small way, the manufacture of grass mowers. The first two-wheeled mower invented by Mr. Wood showed greater advancement in the state of the art at that time than has since been made in any improvement or invention connected with harvesting machinery. The fundamental principle upon which that mower was constructed was a floating frame, to which a cutter bar

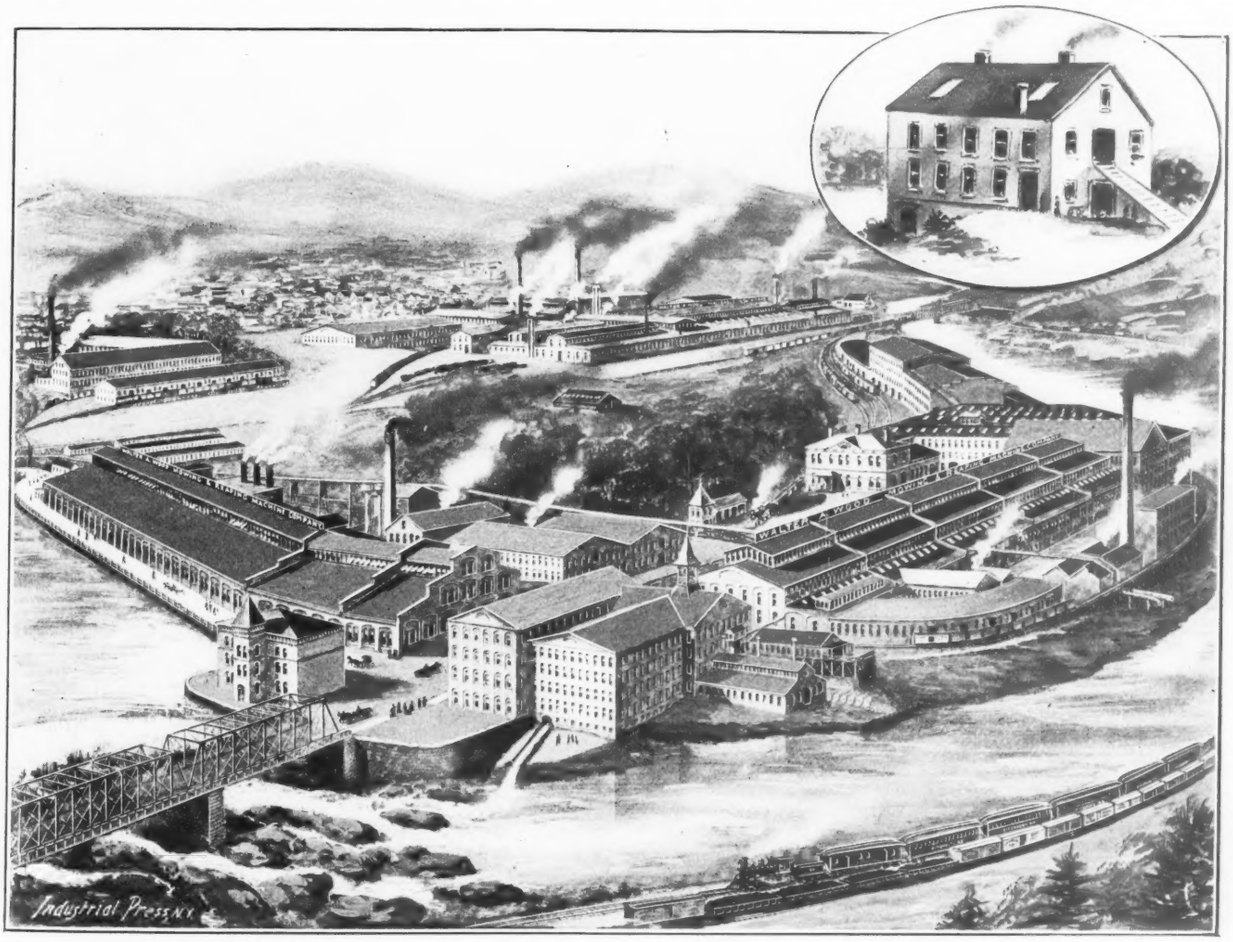

Fig. 1. Works of the Walter A. Wood Mowing and Reaping Machine Co., Hoosick Falls, N Y., with sketch of Original Shop started in 1852.

was rigidly fastened, and by which the relative positions of the pitman crank and scythe head were always maintained, no matter how uneven the surface of the ground. The same principle is used on all mowers to-day.

In connection with the invention and introduction of the mower, Mr. Wood was also active in developing the reaper. In the early sixties, what was known as the Wood chain rake reaper was introduced upon the market, and, at that time, was the best reaper manufactured. It had a large sale for many years and was only superseded by the self-delivery sweep rake reaper, similar to the sweep rake reapers of the present day.

History of the Walter A. Wood Business.

The inception of the Walter A. Wood works may be said to date back to 1853, when the firm of Wood & Parsons began to make mowers and reapers. Previous to that time Mr. Wood had been engaged with a man named White in making plows, but it was in 1852 or 1853 that he purchased territorial rights to manufacture what was known as the Manny combination mower and reaper. This was a very crude and unsatisfactory device—so much so that only two machines were made the first year. But this unsatisfactory experiment instead of discouraging Mr. Wood, only stimulated his inventive genius and increased his efforts, for he at once began working out that wonderful series of improvements and inventions which have revolutionized the harvests of the world, and made the Wood mowing and reaping machines famous at home and abroad. Each year brought something better; each year brought new triumphs; and with them came extensive additions to the works and increased products, until to-day the plant stands the peer of any machine industry in this country, or in the world, for that matter, and has produced in a single year almost 100,000 machines and when running full employs nearly 3,000 men.

It was in the same year when only two machines were made that Mr. Wood's partner dropped out of the business, and in 1858 his only remaining competitor in Hoosick Falls, Ball & Parsons, gave up business. Mr. Wood's genius for invention and improvement had brought him a clear field. In 1855 while occupying an old foundry building, and needing additional room, he purchased the Tremont cotton factory, and when Ball & Parsons gave up he increased his works by taking the foundry formerly occupied by them. Two years later, in November, 1860, his whole plant burned to the ground. He set to work at once to rebuild, and the Caledonian mill, bought the previous year, served to furnish temporary quarters while the rebuilding was going on. In 1865 the works and business having been steadily growing in magnitude, and its interests reaching out further and further—the machines having been introduced in England—the business was incorporated under the name of the Walter A. Wood Mowing & Reaping Machine Co. The capital stock was placed at $300,000 and was readily subscribed for, and from time to time gradually increased until at the present it is $2,500,000—much of it being held by small holders among the citizens and residents of Hoosick Falls. Mr. Wood was, as a matter of course, made president of the company, and continued as such until the time of his death in January, 1892.

In 1870 another fire swept away the works. But the great enterprise had become too firmly established and too vastly important to be killed by even two disastrous visitations of fire. Steps were at once taken to rebuild the works on even a larger scale. The business continued to prosper and grow, various improvements being made in the machines and additions being built to the works year by year, until 85 acres of ground were required for the plant and nearly a million and a half of machines were made and sold. A series of improvements and inventions went on all the time. Improvements were made in the first combined mower and reaper in 1853, which machine was later perfected. The Walter A. Wood mower was invented in 1859. The self-raking reaper appeared first in 1861 and was further perfected in 1863. The first American mowing machine to be shipped abroad was introduced in England by Walter A. Wood in 1857. In 1874 the self-binder was invented, and it was the Walter A. Wood works that made the first harvesting machine that would bind the sheaves before the grain left the harvester. In these first self-binders wire was used for binding, but this had its disadvantages, and in 1880 twine was substituted. In 1888 the company made the single-apron harvester, with open rear, which was further improved in 1894 and 1897. To lighten the draft of the different machines, rollers and ball bearings were introduced, and machines so improved now stand unapproachable by any other in the world. And so the work has gone on, not only in improvements, but in increase of the quantity of machines turned out. Their banner year was 1892 when 99,366 machines were made and sold, and up to the first of this year the total number of machines turned out and sold foot up in round numbers to almost the 2,000,000 mark.

Brief Description of the Works with reference to the Methods of Manufacture.

Limited space will not permit of a detailed description of all the departments of the great works, a hurried trip through which occupies the greater part of a day; and aside from reference to novel and labor-saving methods of doing certain parts of the work, we will depend upon the photographs and illustrations to give the reader a fair idea of the magnitude of the enterprise. Nearly 95 acres of ground are covered by the shops, foundries, storerooms and sheds of the company. The buildings are of brick and range in size from 40 to 80 feet in dimensions to 85 feet wide by 625 feet long, and from one to five stories high. To traverse the floors of these great buildings would require several miles of travel. The malleable department alone, exclusive of its sheds, has a floor space of over 163,000 square feet, and the two foundries measure 485 x 125 feet and 625 x 85 feet, respectively. What is known as the main shops covers 150,000 square feet on the ground, being a number of connecting buildings in all about 150 feet wide and 1,000 feet long. The shipping department takes a building 60 x 500 feet in dimensions and the wheel factory, a structure 125 feet wide and 274 feet long, while storehouses and sheds cover acres of ground. Two storehouses alone furnish storage for 11,000 machines, and running along the river bank are 500 or 600 yards of storesheds for lumber and other material. On a hill 150 feet high overlooking the works are two immense tanks for storing crude petroleum, which is used in many of the furnaces, and also for baking cores and various other purposes. The oil is pumped through underground pipes to the boiler houses of the various shops, where, by an automatic spraying arrangement, it is fed in a very fine spray to the furnaces by means of a strong current of air. The fire is regulated to any degree of temperature desired by the simple use of a lever.

In several of the foundries is a double-track trolley system for conveying, distributing and hoisting metal, castings and materials. This trolley system extends through a number of the shops and foundries and saves much time and labor. In one foundry five men with the trolley do the work that required the labor of 40 men before the system was introduced. The company has nine miles of railroad track within its grounds and employs two of its own locomotives for switching between the various buildings and shops. Throughout the shops is a complete system of automatic fire extinguishers, while a well equipped fire brigade, with hose house, hose carriage and hose and hydrants, gives additional protection, the need of which the two great fires the company suffered from has taught them.

All through the different departments are numbers of mechanical devices, fixtures and contrivances for saving of time and labor, the inventions of the men who have been with the concern for years. There are special contrivances for taking the rough edges, lumps, pimples and gate marks off castings; special punching devices for punching the teeth for the mowers from flat steel; automatic washer producing machines, and special devices for riveting the guards; a triple power drill for boring the holes in hubs of wheels; a circular automatic drill for boring six holes simultaneously in the guards, plates and finger bars in one operation; and a special machine for stamping the company's trade mark on each piece of metal. Drill jigs, dies of all descriptions, boring, milling, planing and turret lathe fixtures and devices are there by the hundreds, and represent only a part of the mechanical appliances that abound throughout the vast mills, shops and foundries.

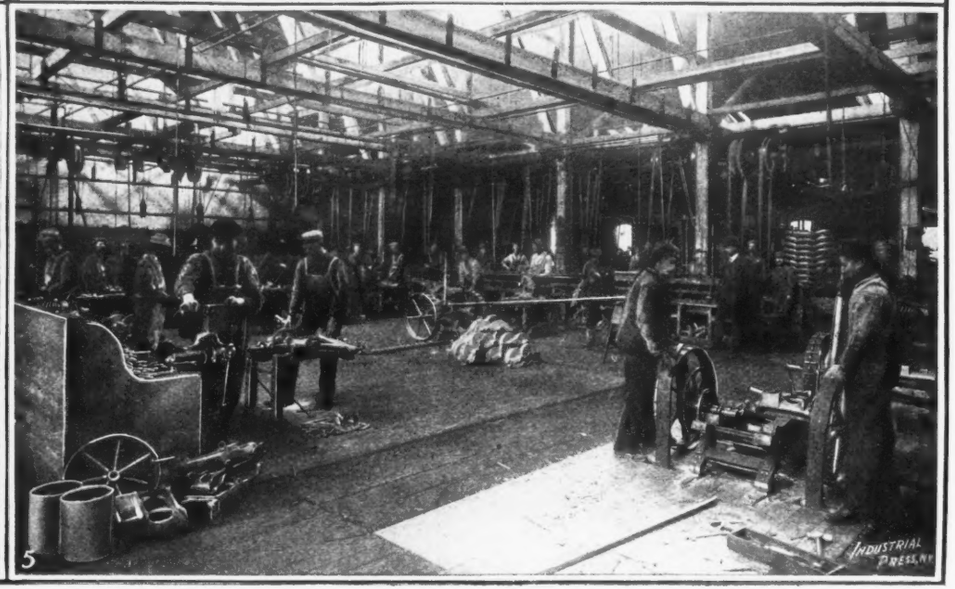

Fig. 2. Molding Room No. 2, Malleable Department, 485 feet long by 125 feet wide. Working 135 Molders and turning out 150 tons of Malleable Castings a week.

Fig. 3. Straightening Room, Malleable Department, where the Castings which have warped during the Annealing Process are Straightened and formed in Dies.

Fig. 4. Machine Shop Manufactory where all large Castings and Parts of Harvesting Machinery are Machined and Finished.

Fig. 5. Mower Room No. 1, where Machines are Assembled and Tested.

To the practical mechanic who has had the privilege of going through shops devoted to the manufacture of agricultural machinery the fact is evident that in them machine manufacturing has reached a point far ahead of the general run of machine practice. In the mowing and reaping machines manufactured by the Wood Company a majority of the parts are of flat or round stock, fastened and assembled by riveting, as in the case of the wheels for such machines, the only cast part of which is the hub, and that is malleable.

One of the things that impressed the writer was the rapidity with which the work is sent through the different operations and assembled. The quickest and most satisfactory results, and the most ingenious attachments and fixtures for the production of the parts are accomplished by the power press.

In the wheel room, where the wheels for the mowing and reaping machines are made and finished, the tires for the wheels (of ribbed soft iron) are cut off to the required length and then have the holes for the spokes, straps and fastening rivets punched in them. This is, to say the least, a very interesting operation, and goes to show the large scale on which press work and punching are carried on in these shops. The tires before being rolled are almost 10 feet long by 7 inches wide and ⅜ inch thick, and the number of holes runs from 81 to 93—all punched at one stroke of the press. The design and construction of the punches and dies for doing the work on the tires entail much accurate work, the punches being so finished as to make the punching of the holes progressive and to allow of the removal of one or a number of dies or punches without disturbing the others. The punches are located in a cast-iron holder, fitted to the dovetailed channel in the face of the ram of the press; they are short and stocky and are fastened by setscrews. The dies are tool steel bushings, hardened and ground and let into holes drilled and reamed in a bolster of similar construction to that used for the punches. The bushings are also fastened by setscrews. The press in which the tires are punched will punch as its limit of capacity one hundred and forty 5-16-inch holes in ¼-inch plate at each stroke of the ram.

The diameter of the holes punched in the tires is usually ⅜ inch, and when it is understood that 93 of them are punched through ⅜-inch plate at one stroke of the press, the size and construction of the presses can be imagined. The holes in the tires into which the spokes are to be entered and fastened, are punched so as to be larger on one side than on the other. Then when the spokes are upset and riveted, the larger portion of the hole will be on the outside of the tire, and when the spoke is upset it fills in the hole and is finished flush with the tire, thereby fastening it permanently without the possibility of pulling out. This does away with the necessity of countersinking, which would require another operation. This peculiarity of the holes is accomplished by making the punches somewhat smaller than the dies.

Next comes the rolling of the tire to the required radius. This is accomplished in a bending machine specially designed for the purpose of bending tires for steel harvester wheels. The rolls of the machine are made of steel and are adjustable for different thicknesses of stock. The ends of the bent or rolled tire are brought together and fastened by riveting a wide cleat on the inside, this being done at one stroke of the power press, riveting sixteen rivets at one blow. The spokes are then entered into the holes, the two sections of the malleable iron hub are trued and fastened to them, and the ends of the spokes riveted within the tire. The cross cleats are then fastened to the outside of the tire by riveting, the hub is set and riveted and the wheel is complete. The different operations on the parts (except the hub) and the assembling and fastening of them together are all done by means of special dies, fixtures and devices in the power press, no screws being used. All parts are riveted throughout. The department in which the mower and harvester wheels are constructed has a capacity of 200 wheels for a day of 10 hours, making the time for the complete finishing of each wheel three minutes. This is rapid production indeed; well nigh impossible to those who have never witnessed it and wonderful to those standing by and watching them being manufactured. The sight of parts being thus produced by punching and the use of the power press, makes the practical man wonder why this machine tool has not been adopted more extensively in the manufacture of machinery.

In the malleable iron department, in which 350 men all told are employed—of which 135 are molders—there is one 14-ton furnace which has a capacity of three heats for a day of twelve hours (four hours for each heat), making the output of molten metal a day from this furnace 42 tons; also two 10-ton melting furnaces with a capacity of three heats a day. In the annealing department, where the castings are annealed and made malleable, are eight annealing furnaces or ovens, to build which required 4,500 red brick and 1,500 white or fire brick for each. Into each of these ovens are packed 20 tons of castings which are kept at a white heat for 84 consecutive hours. All castings turned out in the malleable department are numbered, and after annealing and finishing they are placed in separate bins in the large storehouse. The castings are numbered from 1 to 2503, and are used on harvesters, binders, reapers, three kinds of mowers, two kinds of horse rake, a tedder and a corn harvester.

All the patterns used in the malleable iron foundry are of metal composition, and are kept in a fire-proof vault 65 x 25 by 12 feet high. The value of the patterns stored in this vault runs up to nearly $500,000.

For heating the annealing ovens crude petroleum is used, as previously mentioned, the oil being pumped from three tanks sunk into the ground 300 feet from the ovens. One tank alone holds 13,000 gallons and the other two 6,000 gallons each. In the straightening department, where the castings are straightened and re-formed after the annealing process, there are hundreds of sets of dies, cast-iron dies being used for large parts and hard iron for the dies for small parts. The presses in which the dies are used consist of one hydraulic 7-ton pressure press, three 7-ton power presses and one power press with a pressure of 5 tons. There are also two power drop hammers with a blow of three tons.

To one who is familiar with the agricultural methods and implements of different periods and countries, the fact is evident that the present-day farmer should appreciate his advantage over his fellows of ancient times, and of even a few years ago. The open-rear harvester of the present day will cut any grain that grows; will lift it, deliver it to the binder in proper position, produce a firmly-tied bundle and deposit same at the will of the operator. What is more it will do these things day in and day out, season after season, and with ordinary care will show none but ordinary wear. Long grain, short grain, tangled grain—none can escape the reel on these wonderful machines. Their range of adjustment provides for all conditions, and all grain comes alike to the knife. The cutting apparatus is equally efficient and was perfected seasons ago. Improvements have not been found possible or necessary.

The different heights of grain found in every field make it necessary that the cutting apparatus on harvesting machinery be easily adjusted. On the harvester and binder manufactured by the Wood Company the tilt lever is right at the operator's hand, so that he can incline the knife upward or downward at a touch. Further adjustment is furnished by a simple raising and lowering device. A few turns of a crank at the drive and grain wheels and the machine rises or drops as required.

From the platform of one of these machines the grain is carefully, almost tenderly, carried upward between the elevator aprons and laid upon the binder table. No choking, crushing or threshing, as the open-rear plan of the harvester permits of the elevation of the tallest grain that grows. The binding device does its work in the open. Above the table, protected from the flying dust below, the packers form the compact bundle that a farmer likes to handle. To the right of the table the "butting" device is ever at work, pusning here, tapping there, lining up the bundles at the butts with seeming human intelligence. The bundle, completed and tied, is ejected by the discharging arms into a simple bundle carrier. The carrier is automatic, and with a pressure of the operator's foot he says "when" and the bundles are quietly deposited on the ground.

The platform, the frame, the wheels—the foundation of

these machines—are also worthy of attention. The platform is of steel, and there is not a weak point in it. It is built to withstand all the jar, strain, pounding and scraping of the roughest field. The wheels are of steel construction, also built to stand the roughest usage. There is only one way of doing things in the great works—the best way. Steel where steel is best; malleable iron where malleable iron is best; cast iron where neither of the others is best; seasoned wood where nothing else will answer, and roller and ball bearings where they will do the most good.

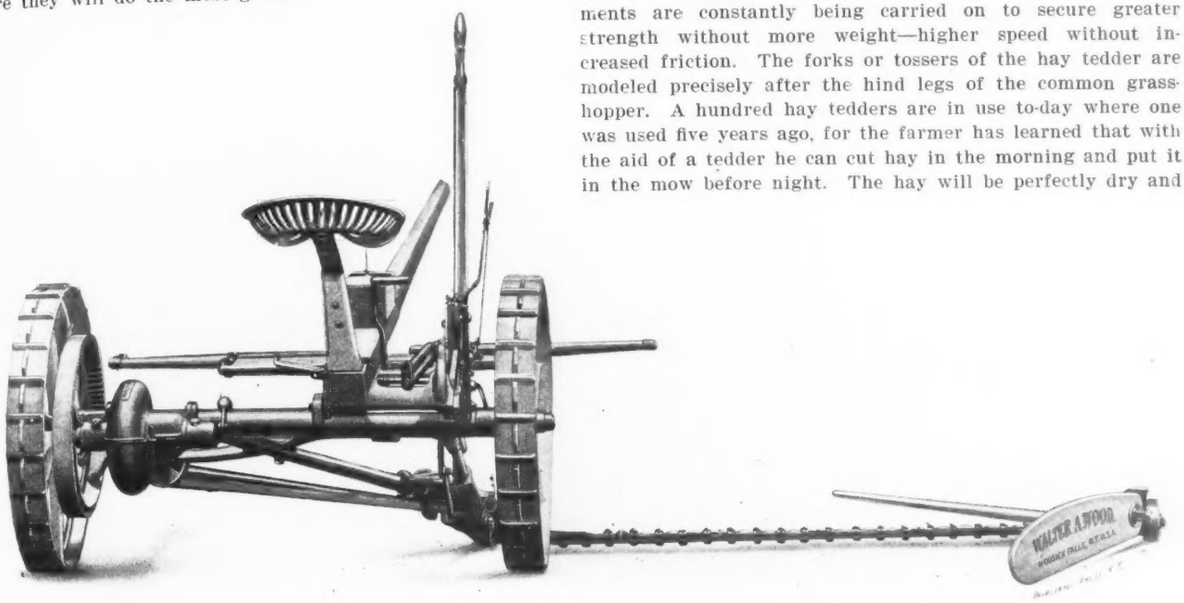

Fig. 6. Rear View of Modern Two-horse Mowing Machine. All Metal Construction except Tongue, Whiffle-trees, Track Clearer and Levers.

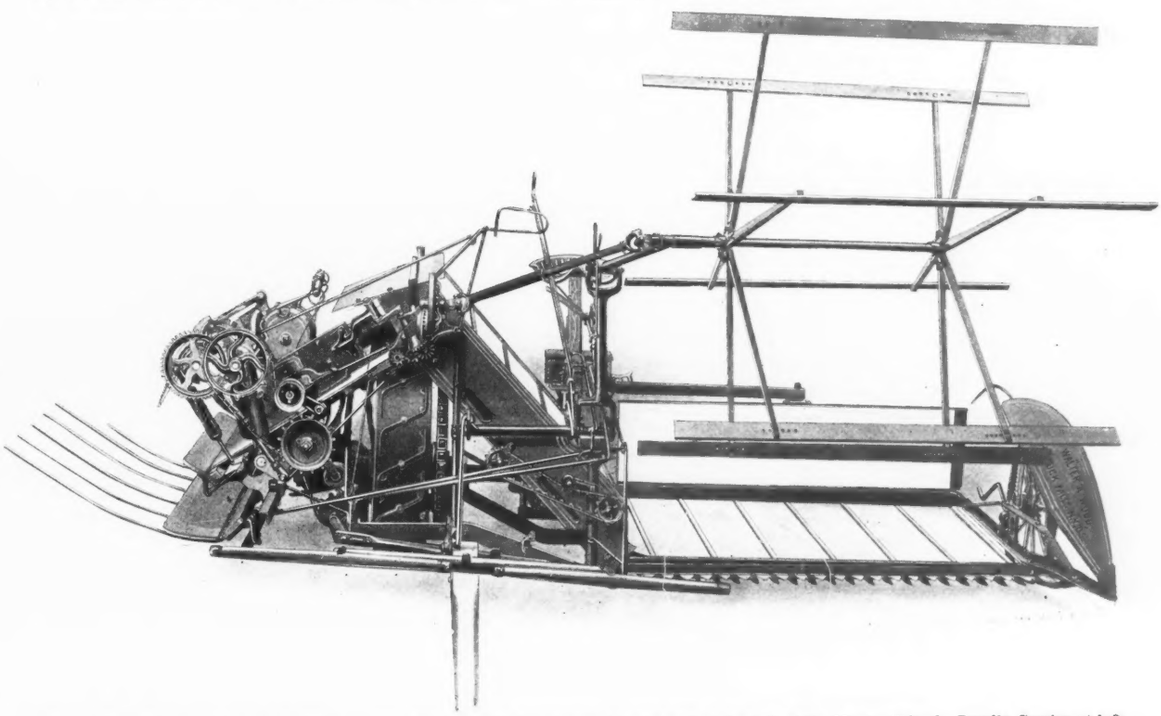

Fig. 7. Front View of Modern Grain Harvester. The Binding Mechanism is over and at the left of the Master Wheel. Bundle Carrier at left.

The giant mowers turned out by the Wood Company will cut a swath 7 feet wide. The main feature of these mowers is the floating cutter frame, which permits setting the cutter-bar at the desired height; and up hill and down dale, through hollows and over ridges, it will cut all the grass at the same height, until readjusted. A rigid-frame mower will not do this. Both cast and steel wheels are used on the mowers. The demand favors the cast wheels; but in certain sections of the country, farmers insist upon having steel-wheel mowers. In the steel wheel the hubs are riveted under a pressure of 200 tons; thus their strength can be better imagined than estimated. On all the mowers the gearing is protected from dust, and roller bearings are used throughout, eliminating all unnecessary friction. In the exhibition room of the Wood works they have a mower of the vintage of 1860. It has seen active service for forty seasons and still performed its duties faithfully in 1901. The company had to give a new mower to get it.

Improvements in harvesting machinery come slowly at this period of perfection. Still they come occasionally, as experiments are constantly being carried on to secure greater strength without more weight—higher speed without increased friction. The forks or tossers of the hay tedder are modeled precisely after the hind legs of the common grasshopper. A hundred hay tedders are in use to-day where one was used five years ago, for the farmer has learned that with the aid of a tedder he can cut hay in the morning and put it in the mow before night. The hay will be perfectly dry and not bleached out. These hay tedders are built entirely of steel, are perfectly balanced and exceptionally light in draft. There are six hay forks which are readily adjusted at different heights from the ground by the use of a single lever. Each fork has four distinct motions calculated to best separate and toss the hay. The use of these machines has shortened the time and decreased the risk of hay-making.

In the hay-raking machines the teeth are hung to project beyond the center of the rake. Striking the hay, they are forced backward and downward just far enough to cause them

to catch every wisp without raking up the turf. A small lever right at the operator's foot locks the teeth down until tripped by the dumping device. Much of the wear and tear on a rake comes on the hubs. This cannot be prevented. On the Wood rakes this is provided for by making the inner hub separate from the wheel hub, thus allowing the inner hub to be easily replaced and the same wheel to be used during the life of the rake. The rake wheels are made in the same manner as the harvester wheels, but with concave tires, which prevents them from sinking into the loose hay.

The sickle and tool grinder shown in the cut, Fig. 11, is another machine manufactured by the Wood Company, and

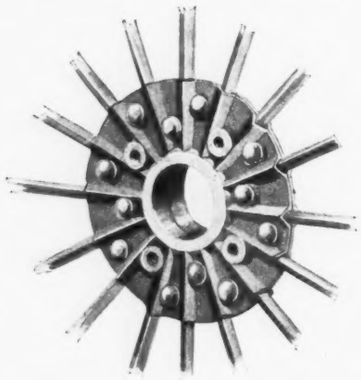

Fig. 8. Malleable Hub of Wood Rake Wheel.

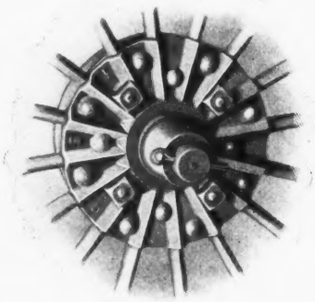

Fig. 9. Two-piece Hub of Wood Rake Wheel complete.

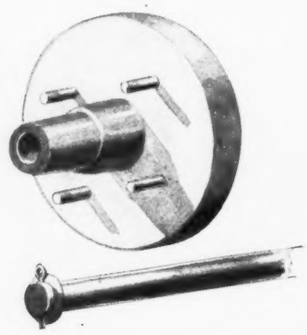

Fig. 10. Cast Sleeve Fitting in Malleable Hub.

might also be used to good advantage for other purposes than the one for which it was specially designed. It possesses a great many desirable features. The 7-inch crank brings 3,500 revolutions per minute of the emery wheel within easy reach. It is entirely automatic; the user turns the crank—the machine does everything else. It is rapidly adjusted both for pressure and position. It does not draw the temper when grinding a sickle, as a very fine steel spring takes the place of human fingers in giving the correct pressure. It has an emery wheel made in two parts, which can be either set together or apart. It can be readily changed into a tool grinder and has a second flat emery wheel for that purpose.

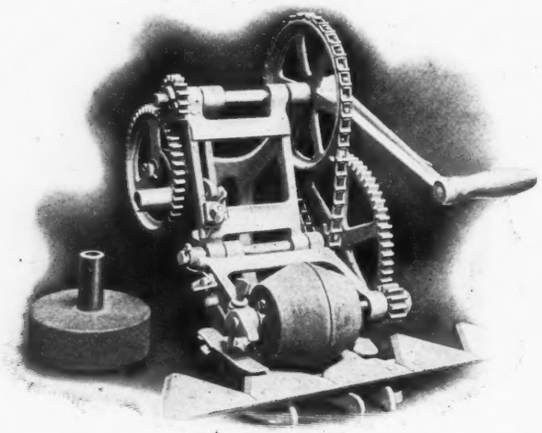

Fig. 11. Paragon Sickle and Tool Grinder.

To run the machinery of a plant like that of the Walter A. Wood Mowing & Reaping Machine Co., requires a great amount of power. This is supplied by both steam and water. There are two water wheels of 1,000 horse power each, twelve boilers and seven principal engines, whose total power is 1,220 horse power. In the main shops there are five boilers and a 300-H.P. engine; in the flat shops, or carpenter and wood-working shops, two boilers and a 200-H.P. engine; in the gray-iron foundry, three boilers and a 100-H.P. engine, and in the malleable works, two boilers and 150-H.P. engine. There are dynamos and engines for lighting purposes, and pumps for pumping oil and compressed air to different parts of the works. In the malleable department there is one pump that has not been shut down 10 hours in a year.

The labor required to run the works at its full capacity demands almost 3,000 men, many of them the best skilled mechanics in the country. We may say that we have never seen finer tool or pattern work turned out anywhere than we have in these shops. The present force does not number 3,000, this being the dull season. The weekly wages when the shops are running full reach a total of almost $40,000.

All the work undergoes a most thorough inspection and testing—first, the parts by themselves in the departments in which they are machined and finished, then the machines, which, after being completed, are set up and tested as a whole. Thorough workmanship is demanded in every department and the very best materials obtainable are always used, with the result that every machine turned out is perfect, durable and reliable in every way. Otherwise the company could not furnish, as it does, a warranty with every machine.

In the summer of 1899 the company put out its new harvester and binder, which has been greatly improved and which to-day has no superior for practicability, strength and durability, combined with lightness of draft. Also in that year appeared the tubular steel mower, the self-dumping hay rake, the hand-dumping hay rake, the hay tedder and the enclosed gear reaper. Of course these machines are made in different sizes and vary in pattern and style, so that the actual number of different kinds of machines being made is very large compared to the above list. Separate or extra parts are made and sold for every part of the machines. Custom work is also taken at the malleable works, where some of the best work of its kind in the country is done.

For several months the engineering force of the company has been busy installing an important addition to its power plant. The work is now completed and the new engine was put in operation early in April. It is a Harris-Corliss cross-compound condensing engine with a 20-inch high pressure cylinder, a 36-inch low pressure cylinder and a 48-inch stroke. It can be used either as a condensing or non-condensing engine, and either side can be run independently of the other. The flywheel is 18 feet in diameter with 52-inch face. It is run at the speed of 80 revolutions per minute and takes a 3-ply belt, 48 inches wide and 233 feet long. With 150 pounds of steam pressure the engine easily develops 750 H.P. The new engine furnishes power for driving machinery in certain sections of the main factory building. It is supplemented in this work by the two large turbine wheels, the power of which is naturally affected by the water supply. Altogether the horse power available at the plant runs well up into the thousands.

Honors have been poured in generous proportions upon the person and works of Walter A. Wood. As early as 1857 the United States Agricultural Society awarded Mr. Wood and his products its highest prize and this has been followed by similar awards in succeeding years. In all, at home and abroad, his machines have received over 1,300 first prizes—gold, silver and bronze medals. In 1869 Napoleon III. of France conferred upon Mr. Wood the Imperial Cross of the Legion of Honor, and in 1873 the emperor of Austria decorated him with the Knight's Cross of the Order of Francis Joseph, while in 1878 the President of France presented him with two gold medals and raised him to the rank of officer of the Legion of Honor.

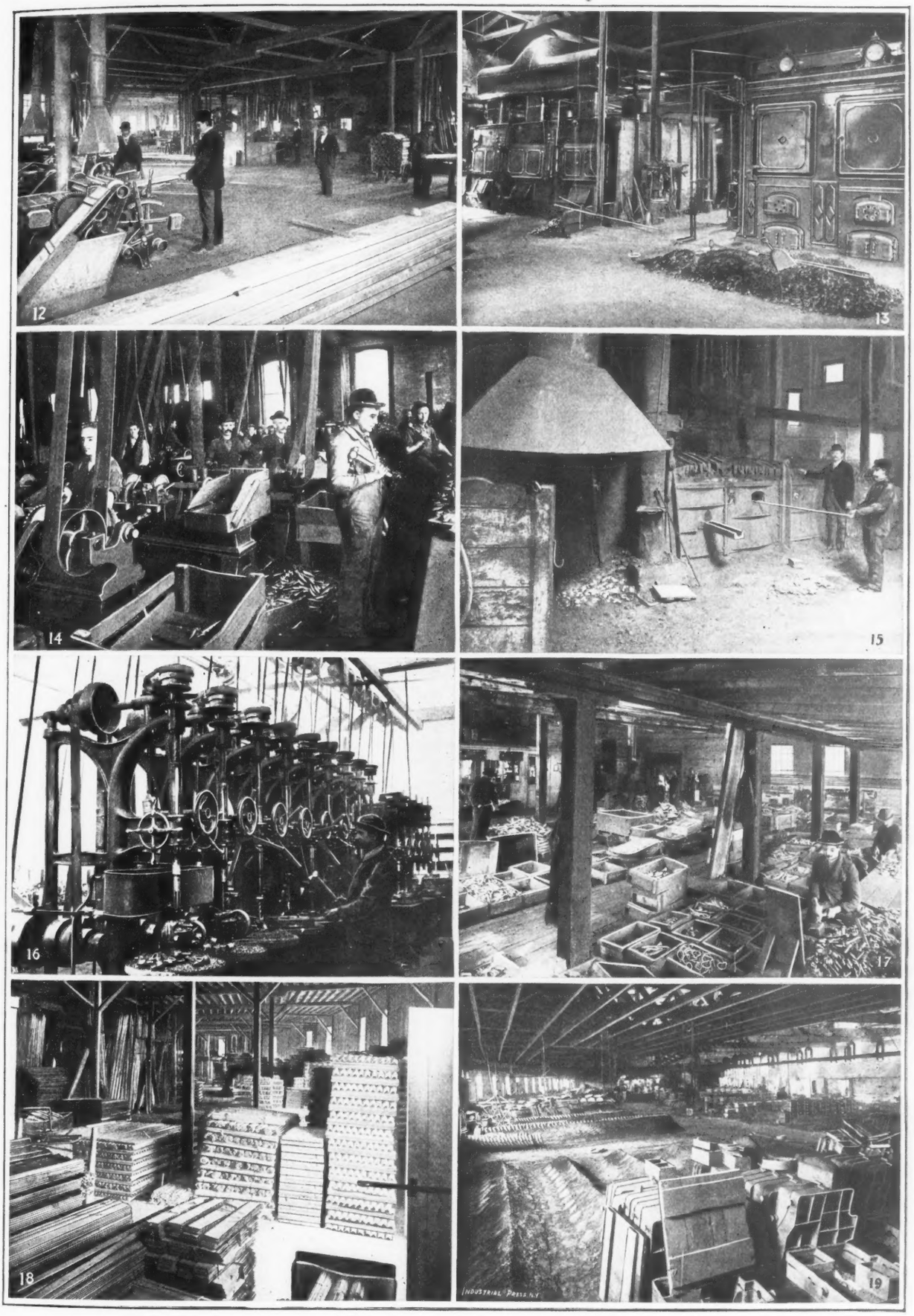

Fig. 12. Carpenter Shop on "The Flats," where the Woodwork of the Harvesting Machinery is Prepared and Finished.

Fig. 13. Boiler Room, No. 1.

Fig. 14. Guard Room, where Guard Castings for Mower Teeth are Straightened, Machined and Finished.

Fig. 15. Fourteen-ton Furnace in Malleable Department. Capacity 42 tons a day, running with three heats of four hours each.

Fig. 16. Gang Drills, Main Factory, with Jigs and Fixtures for the Machining of Interchangeable Parts of Mowing and Reaping Machines.

Fig. 17. Chipping Room, Malleable Department, where Lumps and Gate Joints on Hard Castings are Removed before Annealing.

Fig. 18. Store House, No. 1, where Iron and Steel Raw Material is stored.

Fig. 19. Gray Iron Foundry, No. 1---625 feet long and 85 feet wide.

ELECTRICITY AT THE NEW YORK NAVY YARD.*

ESSENTIAL FEATURES OF THE ALTERNATING SYSTEM USED IN THE STEAM ENGINEERING SHOPS.

Before deciding upon the electrical equipment for the new shops of the New York navy yard, a careful comparison was made between the direct-current and alternating systems. In finally adopting the latter, the officers were largely influenced by two facts—the greater flexibility of the alternating-current system, and the small amount of attention required by alternating-current polyphase motors. It is very possible that in the not far distant future additional shops will be erected in the Yard, in which power will be required; these shops may or may not be built near the power house. With the alternating-current system installed the static transformer, a very efficient piece of apparatus, provides a means whereby the generator voltage may be raised and the necessary power transmitted to any required distance without appreciable loss, and without the expenditure of large sums for the heavy copper conductors demanded by low-voltage direct currents.

At the end of the transmission line step-down transformers are employed to reduce the voltage to the same value as that of the generators, and thus the motors there operated may be of the same standard characteristics as those installed in the shops near the power house.

The second consideration, that relating to the handling of the individual motor, is of serious moment, as those who have had experience with sparking commutators, and the many other ills to which the D. C. motor is heir, can readily testify.

In the modern polyphase motor there is presented the simplest piece of rotating electrical machinery now on the market; and it is consequently especially adapted for use in industrial plants where the best of care is not always given to intricate mechanism, and where the motor is necessarily placed in charge of workmen inexperienced in electrical matters.

These motors are so designed and constructed that they require a minimum amount of attention, and in fact all that is necessary is to start and stop them, as occasion demands, by throwing a simple switch, and to make a weekly inspection to see that the oil pockets are kept filled to properly lubricate the bearings; further, they will stand almost any amount of abuse in the way of overloads, etc., without being damaged.

Another feature of this type of motor is that all of the machines can be controlled by starting or stopping the main generators, and without any attention being given to the individual motors. This makes a shut-down for the noon hour a very simple matter, and renders unnecessary the amount of labor involved in the use of any other form of power.

Detail specifications were drawn by the Bureau of Steam Engineering, and the contract for the entire plant was finally secured by the Westinghouse Electric and Manufacturing Co.

The power used throughout the steam-engineering shops, with the exception of that for the cranes, is furnished by alternating-current motors, directly connected to the larger machine tools, and belted to countershafting for driving the smaller tools.

The various machinery used in the foundry, blacksmith shop and pattern shop (which buildings were not destroyed and have not been rebuilt) is also driven by alternating-current motors.

The crane equipment consists of three cranes in the machine shop and three in the erecting shop, all of which are operated by direct-current motors, the power for which is obtained temporarily from direct-current generators. The plan is to ultimately install rotary converters for such service, these machines to be operated from the main alternating-current generating plant.

The power house was designed by the Bureau of Yards and Docks, and built under the supervision of the navy yard authorities. The building is 100 feet long by 86 feet wide, built of brick with granite trimmings, and is located at a distance of about 60 feet from the machine shop, boiler shop and erecting shop.

Brief Specifications of the Power Plant.

The original idea was to place the power house within the rectangle made by the shops, but in order to afford the shops as much light as possible, and also to minimize the fire risk, the present location was decided upon. The foundations for the building and for the engines, generators and boilers installed therein are of concrete and are built on piles.

The engine room, separated from the boiler room by a brick partition, is 97 feet long by 36 feet wide, and is arranged to accommodate four generator outfits, the necessary exciter and switchboard equipment, and the condensing apparatus; also the boiler feed pump, the air pump and the circulating pumps, which latter are motor driven.

The engine room floor is 4 feet above the ground level, and an 8-foot basement is provided for the reception of the condensing apparatus and all piping and wiring. The boiler room, 96 feet 8 inches long by 45 feet 2 inches wide, is arranged for three Babcock & Wilcox boilers of 300 horse power each, and space is provided for the installation of one 100 horse power boiler with independent steam-driven feed pump, and for the coal and ash-handling apparatus, the mechanical draft and the Roney mechanical stoker, all of which machinery is also driven by alternating-current motors.

All of the apparatus in the power house, with the exception of the electrical equipment, was installed under the supervision of Westinghouse, Church, Kerr & Co., the Westinghouse Electric and Manufacturing Co. (the main contractor) furnishing the entire electrical equipment, including the generators, exciters, switchboard and auxiliary motors.

Three engine-type generating units, as called for in the contract, have been installed. The engines are of the vertical cross-compound type, and were manufactured by McIntosh, Seymour & Co. The high-pressure cylinders are 16 inches and the low-pressure cylinders 34 inches in diameter, the stroke being 36 inches. The engines operate at a speed of 136 revolutions per minute, and are rated at 630 horse power each, at an initial steam pressure of 160 pounds and a vacuum of 26 inches. Each engine is equipped with an electric governor, by means of which the speed can be varied 3 per cent in either direction from the normal while the engines are in operation. The motor actuating this governor is situated on the engine flywheel. Aside from this electrical governor, a centrifugal governor is supplied to closely regulate the speed of the engine, which feature is so vital to the successful operation of alternating-current generators in multiple. A Westinghouse vertical, cross-compound, high-speed engine is provided, to which one of the two exciters furnished is directly connected. The high and low-pressure cylinders are 8 inches and 13 inches in diameter, respectively, and the stroke is 8 inches. The engine operates at a speed of 375 revolutions per minute and is rated at 60 horse power at a steam pressure of 160 pounds and a 26-inch vacuum. The steam piping is arranged so that this engine, or any one of the three main engines, can also be run independently non-condensing.

The feed pump is of the Blake pattern, and is connected to its driving motor through a set of double reduction gears, being designed to run at a speed of 32 revolutions per minute; there is also a Blake single-acting plunger pump installed as an auxiliary feed pump.

Specifications of the Electrical System.

After careful consideration as to the electrical characteristics of the generating units, it was finally decided to install a system having low alternations and operating at a low voltage. The low speed of the engines, 136 revolutions per minute, as above given, required fewer poles with generators so designed and, therefore, the adoption of such a system meant a reduction in the diameter and size and, consequently, in the cost thereof.

The probable use of rotary converters for furnishing power to the direct-current crane motors was also taken into consideration and, inasmuch as there is a well known objection on the part of the majority of the builders of such apparatus to high alternation rotary converters, it was decided that it would be best to install a 3,000 alternation system.

* Abstract of article contributed by F. N. Kollock, Jr., in the Journal of the American Society of Naval Engineers.

In deciding the question of the voltage to be employed, the object was, of course, to have as low a voltage as possible, to lessen the possible troubles due to breakdowns of insulation, and still have it high enough to reduce line losses to a minimum and cut down the necessary amounts of copper in electrical apparatus and line wires. The proximity of the power house to the shops in which the power was to be utilized made a high voltage unnecessary, and this fact, together with the increased safety to attendants in the power house and the workmen, unfamiliar with electrical machinery, in the various shops, convinced the naval authorities that an electro-motive force of 220 volts at the generators would best meet their requirements. It was further decided that a two-phase system would be best under existing conditions.

The three generators therefore, as called for by the specifications and furnished under the contract, are designed to operate at 25 periods per second or 3,000 alternations per minute, two-phase, and at an electro-motive force of 220 volts; the speed being 136 revolutions per minute, the number of poles is fixed at 22. The generators are of the revolving-armature type.

The makers have guaranteed for these generators an efficiency at full non-inductive load of 94½ per cent; at ¾ load, an efficiency of 93 per cent; at ½ load, an efficiency of 90½ per cent, and at ¼ load, an efficiency of 84 per cent, the figures being based on measurements of the copper and iron losses separately determined and exclusive of friction. The guaranteed regulation is a rise in voltage of 6 per cent, full non-inductive load being thrown off, constant speed and constant separate excitation obtaining.

For the excitation of the three alternating-current generators, two direct-current outfits are provided, an engine-driven exciter and a motor-driven exciter. Either outfit is of sufficient capacity to excite two generators under any conditions of load, and, as the present requirements for power can easily be met by two machines, the third being kept in reserve, it will only be necessary to operate one of the exciters at a time. The engine-driven exciter will be used when the alternating-current machines are being started, and, after their voltage has been brought up to normal, the exciter driven by the alternating-current motor will be put in service and the engine-type outfit shut down.

When direct-current generators are run in multiple the only requisite is that the electro-motive forces generated by the machines under consideration shall be the same. In the multiple operation of alternating-current generators not only is this required, but also the most careful design is necessary to insure the generators having the same wave form; and, further, the regulation of the driving engines must be such that at all loads the angular velocity of the revolving element of the generator shall be practically constant. In large engine-type outfits, such as those under discussion, in which the generators have a large number of poles, this latter requirement is of special importance. The total variation in speed during one revolution (that is, the amount which the revolving element forges ahead plus the amount it lags behind the position of uniform rotation) must not exceed 1-30 of the pitch angle between two adjacent poles; and where the poles are very close together the equivalent percentage of the circumference of the revolving part is very small. In the case of these 22-pole machines the maximum permissible variation on either side of uniform rotation is .27 degrees, or .0750 per cent of the circumference of the armature.

The securing of such uniform speed is accomplished by means of very heavy engine flywheels having great inertia, which inertia tends to overcome any speed variation due to sudden changes of the load. These changes are apt to be so rapid and of such brief duration that any form of engine governor is entirely inadequate.

Engines which are to be used to drive alternating-current generators, especially those to which the revolving element of the generator is to be rigidly connected, should, however, be equipped with governors of the most approved type for regulating within the ordinary limits; and, further, these governors should be adjustable while the engines are running, in order to facilitate synchronizing the machines.

The motors used in the power distribution are known as the "Type C" motors, which have a torque, at starting, several times the value of the full load torque. This is considerably higher than is required or desirable for motors used in ordinary machine-shop practice, as the driven tools are usually started without load, and, further, the resulting mechanical shock to the machinery is to be avoided. Another point to be considered is that, with the use of lower starting torques, the starting current taken by the motor is reduced, it being proportional to the starting torque, and for full-load torque about two and one-half times full-load current.

By means of a pair of auto-transformers placed between the line and the motor the electro-motive force at starting may be lowered as desired, and the torque correspondingly reduced. All of the motors installed in the navy yard are equipped with devices of this kind, except those of a capacity below 5 horse power, in which case there is no necessity for their use. Each of these consists of a marble panel, on which are mounted the necessary controlling switches and two auto-transformers, which latter are mounted in separate cast-iron cases and arranged to be placed apart from the panel and connected thereto.

Each of these starting panels carries a four-pole double-throw switch for throwing a low voltage on the motor terminals at starting, and, when full speed has been reached, applying full-line voltage by throwing to the other position; also, a main four-pole single-throw switch for cutting the motor entirely from the circuit, and, in some cases where it is necessary to run the motors in either direction, a two-pole double-throw reversing switch. The two auto-transformers are connected between one side of the starting switch and the motor, and are provided with a number of loops. By this means the electro-motive force applied at starting may be reduced at will to meet the requirements of the service on which the motor is working.

When it is desired to stop the motors the circuit is broken by means of the four-pole single-throw main switch, except in the case of the large motor, where circuit breakers are provided for this purpose on the starting panel.

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ELECTRICITY AT THE ROANOKE SHOPS, N. & W. RAILWAY.*

THIS LARGE PLANT HAS RECENTLY BEEN EQUIPPED WITH THE DIRECT-CURRENT SYSTEM.

Elsewhere in this number is a description of the essential features of the electrical installation at the shops of the Steam Engineering department of the New York Navy Yard. The alternating system is used in the new navy yard plant, for reasons set forth in the article mentioned, and in this connection it will be of interest to give an abstract of a paper presented before the recent meeting of the Master Mechanics' Association upon electric driving for shops, by C. A. Seley, in which the direct-current system is advocated. The paper refers to the electrical equipment of the Roanoke shops of the Norfolk and Western Ry. A year ago the work at these shops had developed to such an extent that additional buildings were planned, necessitating a rearrangement of the power transmission system, and a new electrical system has been partially installed. The Roanoke shops are required to take care of the medium and heavy repairs on 500 locomotives, and to build one complete locomotive a month, and about 1,000 cars a year. In addition considerable new passenger equipment must be built, and repairs must be made on 1,600 freight cars per month, on all the passenger cars of the road, on switches, coal piers, etc.

A varied, scattered power service had been built up, consisting of two main power plants and five auxiliary plants in different parts of the works. It was desired to do away with these as far as possible and concentrate the power at a central station.

The direct-current system of electric transmission of power and lighting was adopted, using two-wire, 220-volt current for motors and three-wire system for lights. This was determined upon after visiting a large number of plants.

* From a paper presented at the recent convention of the Master Mechanics' Association.

Specifications for the Installation.

Instead of preparing a set of specifications requiring a definite arrangement of the electrical machinery, it was thought best to issue an invitation to the electrical companies to tender on such forms of apparatus as in their opinion would best suit our needs, these needs being fully set forth for their information.

The instructions relative to the general layout read as follows: "There are to be three generators, each directly driven by a compound, non-condensing engine. Inasmuch as two voltages are desired, namely, 110-volts, three-wire system for lighting, and 220-volts for power circuits, the arrangement and design of these generators may be proposed in more than one form, to permit delivery of current from the switchboard of either power or lighting voltage from any combination of the generators." A schedule of the power and lights probably required was then given, covering the twenty-four hours. The instructions then proceed: "All generators must be of the latest and most improved type. They must be guaranteed by their makers to develop electrical energy specified, and the guarantee should state the electrical efficiency and also the limit of heating with the rated load."

The system of shop lighting has been series, constant-current, double-carbon, open-arc lamps for general illumination and 110-volt incandescent lamps on alternating circuits. The new system puts the power and lights on the same current, using more than one unit for generating, lessening thereby the probability of a breakdown affecting the continuity of service.

Direct-current machinery was chosen on account of its applicability to all the classes of service required, and for three principal reasons: First, for use in crane service, as being best adapted to that work. Second, by reason of the slower speeds of direct-current motors, they are more readily directly belted to line shafts and machines without the use of intermediate countershafting. Third, alternating-current motors are very enticing on account of their simplicity and ease of repair, and I have no doubt that their makers and users have very convincing arguments for their adoption and use; they are, however, far more expensive per horse power than direct-current motors. Great care has to be taken in wiring for the alternating-current systems to avoid trouble and losses from induction and cross currents. No trouble of this kind is experienced with the direct current if care is taken to properly proportion the wires for their load and the ordinary precautions in regard to insulation are followed. The alternating current certainly has its field in long-distance transmission, where a cheap source of power can be reached and by high voltage be economically transmitted. In such a case the final voltage and its mode of distribution must be determined by local conditions and with special reference to the work to be done.

The bidders were requested to fulfill the following conditions in their tenders on the switchboard: "The switchboard to be of marble, provided with one ammeter and one voltmeter for each generator; two recording wattmeters (one for each side of the three-wire circuits); one recording wattmeter for power circuits. To have also automatic cut-outs for guarding against overloads; lightning arresters, and the necessary fuses. Triple bus-bars are to be provided for light circuits and double bars for power circuits, and suitable switches are to be provided to throw the current from any generator to either the lighting or power circuits, and in addition to these there should be a main switch for throwing the two sets of bus-bars together. Contractors are requested to furnish a design of switchboard embodying these features and in addition such feeder panels and switches as seem necessary to operate the plant, taking into consideration the plan of the works and the distribution of power and lights.

"It is desired that the switchboard be of neat design, with all instruments, switches and other attachments first-class in every respect. It is desired to incur no unnecessary expense in elaboration, but to provide every facility for convenient operation, safety and accurate electrical measurements and records. The wiring between the generators and switchboards to be of heavy copper, braided, rubber-covered cable run below the floor in conduits."

A complete plan of the works and yards and the probable amounts of light and power for each location were furnished bidders upon which to base their recommendations and proposals.

The plan finally adopted comprised three generators, one 75-kilowatt and two of 160-kilowatt each. The smaller unit being approximately 100 horse power and the larger ones something over 200 horse power each, it will be seen that by combinations of the generators, 100, 200, 300, 400 or 500 horse power may be transmitted to the board. This is believed to be good steam engineering, as it affords an opportunity to work the engines closely within their most economical range of steam using.

The three-wire system of lighting generally requires two generators to be worked in series, but in this plant, for considerations of simplicity, first cost and general convenience, and for the further reason that the plant is primarily a power plant, the arrangement and voltage of the generators were fixed with a view to all these considerations and operated direct to the board at 220 volts. This being also the proper voltage for the outside wires of the three-wire system the means of maintaining proper balance between the two sides was then considered and arranged by using a motor-generator balancer set of 10-kilowatt capacity. This machine has its controlling switches on a panel of the switchboard and in a simple manner maintains the balance of the two sides, correcting any inequality of current pressure there may be, due to one side being more heavily loaded than the other.

If the plant was primarily for lights, this plan would not have been adopted, as in that case 110-volt generators, in multiple for lights and series for power, as in the Chicago & Northwestern power plant, would be advisable. Care being taken in the distribution of the lights on the circuits, the balancer has little to do and is a simple and effective device. The shops are to a considerable extent wired and equipped with incandescent circuits, 110 volts, alternating current, and it is only necessary to straighten out and extend the service, transferring the feeders to the new switchboard.

General inside illumination is provided for by the use of 110-volt inclosed arc lamps on the same circuit as the incandescent lamps, the arc lamps having opalescent single globes and sheet-iron shades painted white. It is believed that this style of arc lamp is best suited for shop-lighting as against the use of double-glass globes with no shades. The shades distribute downward a portion of the light that would otherwise be wasted upward and do not interfere with the lateral distribution of the light.

The Question of Group Driving.

The question how far individual motor driving should be considered for machines is an interesting one, but it is the belief of the writer that it is not necessary to consider anything but group driving in the average railroad shop.

A machine may be added to any group without seriously overloading the motor, and as there are several groups we may add a number of machines without change of motors. The additional load would be shown at the switchboard, but by reason of the group system it would add but a small amount to any one motor. To illustrate the advantage of group driving, suppose one machine unit takes 1 horse power and is idle one-half the time, two such units can be driven by 1 horse power motor, provided the machines were run alternately; but if both were operated together the motor would be subjected to one hundred per cent overload. If we took ten such units, however, and used a 5 horse power motor, the chances are about even that the motor would be driven to its rating, and they would be infinitely small as to its ever getting one hundred per cent overload.

The extremist in electric driving does not like to use shafting, but as against an almost one hundred per cent increase of total motor capacity required, the low electrical efficiency of small motors and also the high cost per horse power for small motors as compared with those of moderate size and power, a reasonable length of shafting will in the end prove the best investment for our class of work. In a wood planing mill the case is somewhat different. The power required is so much greater for heavy planers, and other continuously operated machines, that individual driving may be attempted,

but even here it may profitably be limited. Saws, shapers, jointers, mortisers, tenoners, band saws, borers, all intermittently operated machines, can be successfully grouped and driven with a fraction of the power required for individual driving.

The motors at the Roanoke shops are in all cases belted directly to line shafting. The writer has seen motors directly attached on the end of line shafting, as at the General Electric Co.'s shops at Schenectady. At another shop back-geared motors were used directly attached, but the gearing was very noisy and neither of these plans employ strictly standard motors.

At the Baldwin Locomotive Works, where both individual and grouped driving are very extensively used, belts are used to the greatest possible extent and in many cases with such short belt centers as to be surprising that good results could be obtained. It was explained that this method was very satisfactory and that after a belt was taken up a few times, in most cases it would run thereafter almost indefinitely, and if it did fail, its replacement was much easier, cheaper and speedier than to repair broken gearing.

On the other hand, many shops employ gear connections between their motors and machines, especially the modern heavy machinery, much of which is now built to be directly driven. Where the gearing can be covered and protected it may do very well, but wear is inevitable and gear breakages are expensive and at times exceedingly inconvenient. There is a very desirable flexibility in a belt connection and if there should be a failure of the motor an extra one can be readily installed if standard types are employed. Some of the electrical companies have developed systems of multiple voltage, which, in connection with double or triple gearing, give a large range of adjustment of cutting speed of tools individually driven, enabling maximum output after proper speed has been determined by experiment. These systems involve the use of considerable gearing, additional wiring and a generating set arranged with reference to the number of the voltages desired. The writer does not favor individual driving as a rule, and multiple voltage was not considered in connection with the plant under discussion.

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STANDARD DRAWINGS.

SUGGESTIONS FOR DRAFTING ROOM STANDARDS.

WARREN E. WILLIS.

In modern machine shops there are standards for nearly everything that is considered important. The probability is that these standards agree with other shop standards; but get a drawing from them and it is a different matter. Most drawing offices have what they are pleased to call a system—a law unto themselves. They make their drawings to suit their own ideas of fitness, without heed of what others are doing; and many have no two drawings alike, in any particular, except by chance. In no other branch of the machine business, or any other business for that matter, would such a lack of uniformity be tolerated.

Some of the things that need standardizing are: Size of sheets, entire; sizes inside of border lines; style of border line; relation of views to each other; standard center lines; ditto, dimension lines; the use of inks other than black; of color washes; a standard method of figuring drawings, including style of integers and fractions, their position with reference to dimension lines and location relative to the plane of view; the use of shade lines and of attempts at shading; of cross-section lining; of position and requisites of titles; of the use of inches up to a certain number; of the use—or uselessness—of the inch (″) mark; ditto of the "one wanted," "one thus," "one of this," "one per set," or "one per machine;" of unusual scales; of finish marks; of standard conventional representations of gear teeth, sprockets, screw threads, helical springs, chains, ropes, etc., and other constantly recurring questions that vex the draftsman possessed of an orderly mind.

In order to settle some of these questions one engineering office employing about forty draftsmen makes use of practically the following:

Drawing Office Rules.

All drawings to be made in accordance herewith:

1. On standard size sheets, within standard borders.
2. Full size, or to as large a scale as possible.
3. All views to be placed in the third angle.
4. Views to be so arranged on sheet as to leave a clear space for the title at the lower right-hand corner.
5. Shade lines, i. e., heavy lines on the right-hand and lower side of solids, oppositely on interiors.
6. Shading, excepting at the intersection of cylinders, not desirable.
7. Use section lines as little as possible.
8. All figures to be at least ⅛ inch high and clear of view.
9. All sizes less than 100 inches to be in inches.
10. No inch marks to be used, except on the 6's and 9's, when alone.
11. The horizontal vinculum between the members of a fraction *not* to be used when the fraction is in connection with an integer; an oblique line *never* to be used.
12. Standard center lines, in thin black.
13. Standard dimension lines, in thin black.
14. Titles should indicate, (a) the object drawn; (b) for whom or for what purpose; (c) name of engineering office; (d) scale used; (e) date; (f) draftsman; (g) checker; (h) number of drawings in set; (i) individual number of drawing; (j) symbol; (k) numerical order of drawing; and when desirable (l) designer; (m) size of sheet, represented by symbol; (n) if detail or assembly, and (o) approved by.

One trouble in formulating such a set of rules is getting at a consensus of opinion; another is the neglect of some important features because it must necessarily be brief.

Take the size of sheet. Some will say that their work demands large sheets. Very well; could they not be standard as well as an inch or two from it?

It would save the new draftsman an inquiry; it would save specifying sizes in ordering paper and would reduce the number of sizes carried in stock, or even made at the mill, while overcoming much of the annoyance in filling "foreign" drawings, besides preserving the valuable principal of uniformity.

But what is a "standard size sheet?"

Look at this list of drawing and tracing paper sizes:

Cap, 13x16; demy, 15x20; medium, 17x22; royal, 19x23; super royal, 19x27; imperial, 22x30; elephant, 23x28; peerless, 18x52; grand royal, 18x24; grand aigle, 27x40; columbier, 23x34; atlas, 26x34; theorem, 28x34; double elephant, 27x40; antiquarian, 31x53; emperor, 40x60; Uncle Sam, 48x120; double crown, 20x30; double D crown 30x40; double D D crown 40x60.

Just think of it; and these are not all the sizes, either.

We all know very well that no draftsman buys paper by such sizes—think of calling for a sheet of "Theorem" or "Uncle Sam"—but that it comes in rolls, or, far better yet, cut at the mills and delivered flat, in sizes as ordered. It is noticeable, however, that this collection can be made to yield a suggestive fact; that the resulting average is 24.77 inches by 37.5 inches, which, reduced proportionately, results practically in 24x36—a reasonable size, and which subdivides conveniently.

If, then, we may take this as a standard, making provisions for a double size and several subdivisions, we may next consider a border. These run, in practice, all the way from 1, ½ inch to ¼ inch. This is extreme in both cases. Room should be allowed for thumb tacks and for general appearance; probably ¾ inch is enough and doesn't look "skimped." Smaller sizes may have less margin if preferred. The style of border may preferably be so that the lines cross each other at their intersections by a small and uniform amount. This can be done quicker and neater, it is thought, than an attempt to make them just meet. Fancy borders are not desirable on working drawings, but shade lines improve the general appearance; all borders should be distinctly heavy.

A space should be provided in the general lay-out of the drawing for the title, which should be placed at the lower right-hand corner. It can be conveniently seen there and is the quite general practice.

One person selected for this work will perform more of it in a far neater and more uniform manner than by having everybody making attempts at it.

Symbols and consecutive filing numbers should be sufficiently large so as to readily catch the eye; in fact, they should be the most prominent thing about the sheet, and it is not a bad plan to have the same repeated on the opposite corner in case the drawing should be turned bottom up. Some may prefer to have the name of the designer, detailer, checker and tracer on the title in full or initials, as well as that of the draftsman responsible, which is required by custom. It might please some to make use of the word "fecit"—made by—in place of the usual "del"—abbreviation of delineator—but the majority would hardly approve.

As to scales, there are more in use than desirable or even necessary, and the use of an odd scale should not be tolerated, notwithstanding the claim made that the use of scales not common prevent scaling the drawing by workmen; but others besides machinists may want to "check up," and then it becomes awkward, to say the least, especially if that particular scale is not at hand.

Occasionally drawings will be noticed bearing the phrases, "Do not scale," "Work to figures," "Report all errors to this office," etc. All this seems useless, for general rules and common sense indicate this as clearly as words can do it. It is an insult to the intelligence of the workmen on the part of the draftsmen to try to indicate to him that which is clearly obvious. The date should be given on which the idea was first put into practical shape, rather than that on which any particular drawing is made, on account of future possible conflicting claims; the other may be given in addition, if thought desirable.

The general title—as the name of the machine, the parts actually shown, or the mention of details, the party for whom the drawings are made (if other than the makers) and the engineering office making them—should be given. If likely to be sent away, and hence become "foreign" drawings, the address may also be added.

The number of drawings in the full set and the individual number of the particular sheet in the set should also be given.

A circle in opposite corners, with 3/16 written in the upper half and B.7 in the lower half, would indicate that the sheet was the third in a set of six for the machine known as B. 7. Finish marks should show wherever finish is required or if to be machined all over it should be so stated. A symbol similar to the old-fashioned letter "s" is common and readily understood. Limits should be given when necessary.

Such statements as "one thus," "one of this"—both of which are actual prevarications—should be abolished as time-taking nonsense. The number of pieces required may be given simply in connection with the material to be used and the name or number designating the part shown, and nothing more is required. This had better be written, rather than given in numerals, to prevent any possible error.

If it is generally understood that all sizes are given in inches and fractions thereof, up to a certain definite number, like 100, the inch mark (") may well be neglected as time taking and obscuring to the drawing. On 6's and 9's some prefer to use them for the sole purpose of indicating the position they are to read from. Plain Arabic figures, the fractions smaller than the integers, and used without the dividing line, are thought preferable in making a clear drawing.

All this has been written more to bring out the ideas of others than to air those of the writer, who fully believes the fraternity would be vastly benefited by reasonable standards and who further regards it well within the province, if not the duty, of the leading mechanical journals to take the matter up for the common weal. Like everything else it must have a beginning, and the sooner it is brought about the better it certainly will be. Reforms in other matters have been effected and systematic standards have been evolved in which far greater difficulties were encountered.

While it is admitted that drawings are not in themselves an end, but rather a means to an end, it is equally true that they constitute a sort of universal language in mechanics and the more perfect and uniform this language can be made the better it must be for all concerned.

SIR JOSEPH WHITWORTH'S WORK AT STANDARDIZATION.

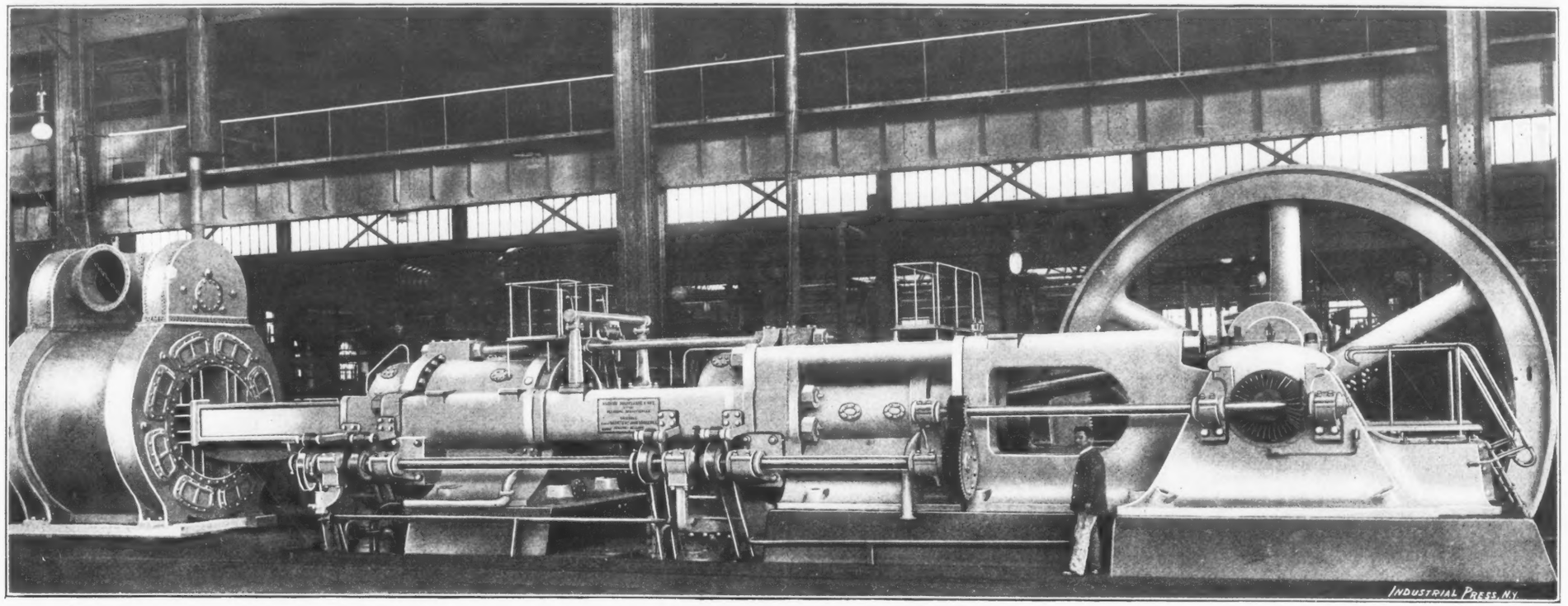
In a United States consular report from Birmingham, England, is the following reference to Sir Joseph Whitworth's efforts at standardization. It was in 1841 that the late Whitworth pointed out the inconvenience constantly arising from the different patterns of screws then employed by different makers of machinery, with the result that a machine in some distant part of the world might be crippled for want of a single screw, and might remain so until sufficient time had been given to send to the workshop of the original maker for the supply of the deficiency. He proposed that manufacturers should agree upon a uniform size and pitch of thread for every diameter of screw or of aperture, and was promptly met by the contention that the form used in every workshop was, in some point or other, better than the rest. Firm A would not use the screws used by firm B, and firm C would have nothing to do with those of either. But the shrewd and patient north countryman was not easily discouraged. He evaded the difficulty by producing the exact mean of the several patterns used by the most eminent firms, and his proposal was adopted by acclamation. He had so far foreseen this result as to have quietly prepared machinery for dealing with it, and when the standard screws were accepted he was at once in a position to supply the tools necessary for cutting them. His attention was soon after diverted to other subjects, but he constantly regretted his inability to deal with other things as he had dealt with screws, and was never weary of expatiating upon the advantages which would accrue to British industry from the national adoption of a sufficient variety of standard sizes in all departments of manufacture. His favorite object lesson was furnished by a candle wabbling loosely in a candlestick, and only rendered firm by a band of paper, or by a candle requiring to be scraped before it could be fixed; and he would ask why candle makers should not agree as to the number of sizes required by consumers, and why every No. 1 British candle should not fit easily and correctly into every No. 1 British candlestick. The iron and timber parts of buildings, such as girders, doors, door frames, window sashes and the like, moved him to wrath by their diversity; and he was accustomed to maintain that the convenience which would be afforded to purchasers by the general adoption of a proper number of English standards and by accurate working to them, would be sufficient to give something like a monopoly of the trade in every branch of manufacture in which the principle was carried into effect.

* * *

There is in use on the river Elbe, in Prussia, a system of steam boats operating by means of chains, which has been employed many years. The chains lie along the bottom of the river which has a swift current, making it impossible to tow barges loaded with freight by ordinary propellers. The chain boats take up the chain from the bow, pass it round a drum which is revolved by steam power and drop it at the stern. As there is but one chain, vessels going in opposite directions must drop it as they pass. This recalls a system of transportation that was in use on the Connecticut River, in New England, before the days of railroads. Much of the way it was possible for steamboats to propel themselves, but there were rapids at intervals which gave trouble. At the head of the rapids was located a windlass on which a chain attached to the boats was wound up, drawing the vessels against the current.

* * *

No less an authority than Col. Henry C. Demming, of the United States Geological Survey, revives the old suggestion that it is not only possible but practicable to utilize the intense heat within the crust of the earth. He believes that steam can be generated at the bottom of a shaft 9000 feet deep. And he would dig two holes not far from each other to a depth of 12,000 feet, connect the two by means of a heavy charge of explosive and then pour cold water into one, when it would run out of the top of the other hole heated to the boiling point or flow out in the form of steam. It now remains for the Colonel to invent a fireproof digging machine for sinking the shaft to the depth of 12,000 feet.



Twelve Hundred H. P. Gas Blowing Engine.

GAS BLOWING ENGINE.

We have previously referred in these columns to the possibilities of blast furnace gas as a fuel for internal combustion motors, and particularly for gas engines of large size for operating blowing engines in steel and iron works. Various experiments have been conducted in this direction on the continent and in England during the past six years. One of the first gas blowing engines to be operated successfully was a 200 horse power engine built by the Société Anonyme John Cockerill, Seraing, Belgium, in 1897. Since that time this company has given a great deal of attention to the design and construction of engines of large sizes for use with blast furnace gas, and one of their latest productions is shown in the accompanying illustration, reproduced from a photograph.

This engine is of 1200 horse power, with two gas cylinders, about 51 inches diameter by 55 inches stroke, arranged in tandem. These cylinders operate on the four-cycle system, enabling a valve gear of simple construction to be used, while in point of regular running the effect is the same as obtained with a two-cycle engine. Another advantage of the tandem arrangement is that while the power is twice that obtained from a single cylinder, the time of explosion in each cylinder can be so timed that the strains upon the engine will be no greater than with a single cylinder engine having half the capacity.

The diameter of the air cylinder is about 72¾ inches, this and the previous dimensions being given in the nearest even inches and fraction of an inch corresponding to the metric sizes. The engine runs at a speed of 80 revolutions a minute and can supply 20,000 cubic feet of air per minute at a pressure of 18 pounds per square inch. The weight of the flywheel is 33 tons and of the complete engine 237 tons.

The gas is ignited by means of an electric coil, and a small electric motor is used for starting the engine. The blowing cylinder, besides the usual suction and delivery valves, has a series of larger valves at each end, which open automatically to give greater ease in starting, or to allow the volume of air to be reduced when its pressure rises too high.

There are at present three engines of this type in existence, two at the works of Messrs. Roechling at Thiouville, in Alsace-Lorraine, and another at the works of the same owners at Volklingen, Rhenish Prussia. Another design practically the same as these but giving 28,000 cubic feet of air at 13 pounds' pressure per minute is built by this company. A new engine of the same power being built for their own works is of the double-acting type with a single gas cylinder. They also have under construction a tandem engine for developing from 2400 to 2500 horse power, which will be used for electric lighting and power transmission. This engine has cylinders 47¼ inches in diameter by 47¼ inches stroke and runs at a speed of 100 revolutions per minute. The cylinders are double-acting and by combining two such engines 5000 horse power may be developed, with sufficient regularity for three-phase currents. The company writes us that they have on hand orders for rolling mill engines, to be worked by blast furnace gas, of 1200 horse power and for even larger sizes.

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AUGUST, 1902.

NET CIRCULATION FOR JULY, 1902,—27,044 COPIES.

NEW EDITION OF "MACHINERY."

Beginning with September next, which will be the first number of the ninth volume, MACHINERY will be published in three editions:

THE SHOP EDITION—$1.00 a year, will be the regular edition now published.

THE ENGINEERING EDITION—$2.00 a year, will include the matter in the shop edition, and also from sixteen to twenty-four pages of engineering matter with a supplement, making a journal which will cover completely the wants of the designing, constructing and consulting engineer, the shop superintendent and head draftsman.

THE FOREIGN EDITION—$3.00 a year, will contain the same matter as the engineering edition, printed on thin paper for transmission abroad.

A number of valuable features will be introduced in the Engineering Edition for the purpose of making the paper a complete record of mechanical progress. It will contain a comprehensive summary of important mechanical and technical events, which will enable a reader to keep thoroughly informed upon mechanical progress; a digest of current technical literature; and the department, "New Tools of the Month," in which are described new tools and machine shop appliances, will be extended so as to include descriptions of more strictly new machine shop products than ever before. The paper will contain a greater variety of technical articles, and a supplement will be included with every number, composed of data condensed from the proceedings of the various engineering societies as well as valuable charts and tables contributed by draftsmen and used in practical shop work, so that readers will have at their disposal the substance of many of the best engineering papers read before the various technical societies and other useful information in a form convenient for reference.

We shall concentrate all our efforts and outlay on making MACHINERY the best mechanical paper published, and on covering its field so completely that no other paper need be read to obtain all the mechanical news of the month.

* * *

EFFECT OF ELECTRIC DRIVING ON MACHINE DESIGN.

The uses of electricity in machine shops and other manufacturing establishments have so far been principally confined to the substitution of electric motors for line shafting and belts and the driving of traveling cranes. The characteristics of the machines themselves have so far suffered little change by the advent of the so-called "electrical age." A lathe or planer designed for electric driving as built by most machine tool builders does not differ materially in design from tools built for line shaft driving, but it is not likely that this condition will long continue in view of the radical departures already made in the design of some other machines in which electricity plays a prominent part in the movements of the mechanism.

As illustrations we will mention the Blickensderfer electric typewriter and the Naylor electrically-operated valve gear for steam engines—two widely separated mechanisms in which electricity is employed in a radical manner. While the operation of the ordinary typewriter is much easier than writing with a pen and much more legible, the labor in the case of expert operators is by no means inconsequential, as it amounts to many hundred foot-pounds daily. In the electric typewriter electrical energy is substituted for muscular energy, so that the operator does not have to pound the keys with force enough to produce type impressions, but merely touches them with force enough to depress them about one-eighth inch against a tension that may be adjusted to suit individual preferences. The depression of the keys makes electrical contacts and the electric current does the actual work of making the type impressions, thus relieving the operator of considerable labor and increasing his or her capacity for work.

In the case of the electric typewriter the object is to substitute electrical energy for muscular energy, because the latter is limited in amount and is comparatively costly. In the electrically-operated steam engine valve gear the object is to control the action of the valves in a quicker and more positive manner than is possible when mechanically operated. While it is yet, we believe, in an undeveloped state, so far as actual application to a commercial engine, it constitutes a most interesting application of electricity and indicates the possibility of increasing the efficiency of the steam engine and adapting it to service of a trying character where the load may vary as much as 100 per cent between the beginning and end of one stroke. This feature would probably be valuable when the engine is of long stroke and great power, as in the case of rolling mill engines. By the use of the electrical gear it is possible to have the cut-off valves open again after they have closed, should the load suddenly be greatly increased at any point between cut-off and release; so that instead of having to wait until the next stroke to get a steam pressure in the cylinder sufficient to balance the load, it is furnished instantly during the stroke in progress. While such an action is, of course, wasteful in one sense, it might easily become a feature of economy in some cases, as it would make the operation of certain classes of machinery much steadier without the use of enormous flywheels to consume a large percentage of the power generated by friction, and which add considerably to the first cost of large engines.

While we are scarcely prepared to predict that designers will produce as great changes and improvements in machine tools, yet it is probably safe to say that the time will soon arrive when the use of splined shafts, bevel gears, etc., to transmit rotary motion from a stationary part to a moving slide, will be generally abandoned on the larger machines in favor of separate driving motors connected to one controlling mechanism by flexible electrical conductors or sliding contacts. This plan has already been used by the Newton Machine Tool Works, Philadelphia, in connection with their heavy, cold saw cutting-off machines. Other improvements that may be adopted are, say, that a heavy lathe headstock will be shifted to any part of the bed by touching a lever; that a planer cross-rail may be shifted vertically and clamped in position without the operator leaving his controller; that feeds and speeds will be as easily changed; that magnetic chucks will be generally employed for holding steel and iron pieces during machining operations, etc.; for all these features mean increased efficiency of man and machine, and are in the line of progress.

* * *

ELECTRO-PNEUMATIC CAR SYSTEM.

At the meeting of the American Institute of Electrical Engineers recently held at Great Barrington, Mass., Mr. Bion J. Arnold, a consulting engineer of Chicago, outlined a new system of control for electric railways. The system is original and is well adapted for heavy railway service. Mr. Arnold is an advocate of the alternating current because, with direct-current motors and long-distance service, a heavy investment in transmission lines is required and there must

be many translations between the power station and the car, owing to the low working voltage. In his new system, which he calls an electro-pneumatic system, an alternating current motor is mounted directly on the car designed for the average power required by the car. This motor runs continuously at a constant speed and constant load, and therefore at maximum efficiency. The motor is so designed that what is usually the stationary part or stator, may revolve in a direction opposite to that in which the rotating part, or rotor, turns. Instead of starting and stopping the motor and dissipating the energy through resistances, as is customary with other systems, he controls the speed of the car by retarding or accelerating the rotor and stator of the motor, by means of compressed air. There are two compressed air engines, one connected to the stator and one to the rotor. These are reversible and may be operated either as air compressors or as air motors.

As with the ordinary alternating current motor, the car is propelled when the rotor turns and in this case the speed at which the car is driven depends upon the speed or direction in which the stator is turning, through the action of its compressed air engine; and also upon whether the engine connected to the rotor is assisting the electric motor. Assuming that the car is at rest, but that the motor is in operation, the rotor would be stationary, while the stator would turn at the speed at which the motor was designed to run, thus driving its air engine and compressing air in the tank. To start the car this air engine would be throttled, reducing the speed of the stator; but since an alternating motor must run in synchronism, the rotor would turn at a speed corresponding to the speed reduction of the stator. Upon throttling still more, the stator would stop and the speed of the rotor and car increase correspondingly. If still greater *speed* were required, the air engine connected to the stator could be made to drive the latter in the direction in which the rotor was turning. If greater *power* were required, the rotor engine would be started to assist the electric current in propelling the car. In going down hill or when the car is stopped the surplus power of the electric motor would be used to compress the air.

It is believed that this system of control will not only give a high efficiency on long-distance transmission lines, but will be particularly valuable in switching work or in running cars over lines not electrically-equipped, as might be the case when running through cities or towns or through the switch yards. A railroad with about 60 miles of track is now being equipped with this system by Mr. Arnold and it is expected that further particulars will shortly be obtainable.

* * *

BATTLESHIP FOR NEW YORK NAVY YARD.

The possibility of the government giving the navy yards important constructive work in the near future, as outlined in the last number of MACHINERY, has now become a fact; and it is announced that one large battleship will be built at the New York Navy Yard. As we have already explained, provision was made by the House of Representatives in this year's appropriation bill for constructing three battleships at government yards. This clause was stricken from the bill by the Senate committee, but members of the House advocated the measure so strongly that a compromise was effected and, as finally passed, the Secretary of the Navy is instructed to have one battleship built at a government yard.

There are several reasons for taking this action. One of these is the desire to give the yards practice in shipbuilding, as a matter of protection to the government. Another is the possibility of labor trouble in private yards should the eight-hour bill be passed which provides for eight hours of work daily only, on government contracts, wherever the work is done. There is probably a desire also to compare the cost of government construction with the cost of work done by private firms. It would naturally be expected, however, that the expense for building the warship now authorized would be much greater if it is constructed by the government than if let outside under contract. The government officers and mechanics have not had the opportunities to acquire experience nor have a system of work and plans for carrying it through been developed. The first machine of any kind always costs a great deal more than the succeeding ones in any shop and the same rule holds, but to a greater extent, in the case of war vessels. Should it happen that the government-built vessel costs less than the price paid private firms for similar vessels it would show conclusively that exorbitant charges had been made by those firms.

If it is intended to make a comparison, of course it would be desirable to have this vessel built under as favorable conditions as possible, and the New York Navy Yard with its superior equipment offers the best facilities. The Norfolk and Boston yards were strong competitors for the work; but no less than two years' time would be required to bring the plant at the Boston yard up to a point where it could undertake the work of building a battleship. Norfolk was handicapped by excessive freight rates on the raw material from the mills to the navy yard. The machinery for the battleship will be under the charge of Commander J. A. B. Smith, of the New York yard, who is considered one of the most efficient engineers in the navy. The hull work will be under Constructor Washington L. Capps, who has had an extended experience and was the officer sent to the Philippines shortly after the battle of Manila Bay, to inspect the ships of Dewey's fleet and take charge of any needed repairs.

* * *

NOTES AND COMMENT.

The various engineering colleges to-day receive gifts more frequently than ever before, owing probably to the greater attention that is now being given to the importance of training for industrial work. It is announced that $250,000 has been subscribed toward a $500,000 engineering building for the University of Pennsylvania at Philadelphia, which in many respects will be the finest building of its kind in the country. It is also announced that Frederick W. Vanderbilt has purchased a large tract of land for dormitories which will be built at his expense for the Sheffield scientific school at New Haven, Conn.

The great Massena, N. Y., power plant which derives its power from the St. Lawrence River has been sold under foreclosure proceedings for $500,000, which is only one-twentieth of what the enterprise is estimated to have cost. It is not stated in the press reports whether the sum paid for the property gives exclusive title to it. The property includes a canal over three miles long, connecting the St. Lawrence above the Long Sault with the Grasse River at Massena. The original company had a capital stock of $6,000,000, which, however, was soon exhausted and a new company was formed. It later became necessary to mortgage the property and finally the point was reached when there was no money to pay interest charges and the company was obliged to sell it.

A correspondent, "C. M. Y.," Bethlehem, Pa., writes as follows regarding what we have called the "Kennedy System of Keying:"

In the June issue of MACHINERY on page 305 a method of keying flywheels is illustrated in which two pairs of taper keys are used, obviously with the idea that one key shall not drive in both directions. Mr. Julian Kennedy, of Pittsburg, is named as the originator of this method of keying and in the July issue it is referred to as the Kennedy system. While we have not sufficient ground on which to make any positive assertions, this might be considered a proper time to mention the fact that this same system of keying is illustrated by Reuleaux in his book "The Constructor," and is attributed by him to Engineer Peters.

The trustees of the Massachusetts Institute of Technology, Boston, have established what is known as a course in insurance engineering. Its object will be to instruct the students in the selection of materials and the safe construction of buildings, as well as in estimating fire losses and determining what are safe risks for insurance companies to take. There appears to be a good opening for graduates who have taken the studies outlined for this course. There is little doubt that a large percentage of the fires which occur are from pre-

ventable causes. There is also a tendency among merchants and others to over-insure their stock, which makes them careless in the matter of fire protection. Insurance companies are glad to avail themselves of any feasible means to reduce fire losses from these causes. A young man with a fair knowledge of chemistry and of constructive materials, and with experience in valuating property, should be able to render valuable services in the cause of safe insurance.

AN EXAMPLE OF SUPERHEATED STEAM.

What is probably the best example of the advantage of superheated steam to be found in this country is the White steam carriage manufactured by the White Sewing Machine Co., Cleveland, O. A flash boiler is used with this automobile which superheats the steam and Prof. Thurston reports that with one of the engines working at about 5 horse power the consumption was less than 25 pounds of steam per brake horse power per hour. The usual consumption of engines of this size using saturated steam is about 75 pounds per horse power per hour, or more. It is well known that the larger the engine the more economical it is, other things being equal. The losses, where saturated steam is used, are mainly due to the initial condensation of the steam upon the cylinder walls, and the re-evaporation of part of this condensation during the exhaust. The larger the cylinder, the less the area of the surface to produce condensation, in proportion to the volume of steam used. The 5 horse power engine of the White steam carriage, however, is as economical as a Corliss engine of, perhaps, 100 horse power running non-condensing, and its performance is as good as that of a condensing engine of the single-valve type but of large size, saturated steam being used in the larger engines. Superheating the steam reduces the condensation in the cylinder and if carried to a sufficiently high temperature may eliminate it altogether. It thus makes very little difference what the size of the engine is, as far as steam consumption is concerned, when superheated steam is employed.

REGULATIONS FOR FLYING MACHINE CONTESTS AT ST. LOUIS.

Meetings were held in July by the American Association for the Advancement of Science at Pittsburg, Pa., and at the meetings of the mechanical science and engineering sections Dr. Woodward, who presented the rules, said that many people believed the airship contest would be of little practical value. He told an anecdote, however, to the effect that Prof. Lovering of Harvard University lectured to his (Dr. Woodward's) class many years ago upon the Atlantic cable and demonstrated to his own satisfaction that telegraphic communication under 3000 miles of water would be an utter impossibility. In the same way scientists might be mistaken about the practicability of flying machines.

Two hundred thousand dollars has been appropriated by the Fair board for successful competitors in the airship contest. There is no limit to the number of competitors, the power used, or the mechanical principles involved. The balloons and airships must carry one passenger and the competitor must have made a trip of not less than a mile with a machine similar to his entry.

The entrance fee is $250 each, which will be refunded when the entry appears on the day of the race scheduled. To win the first airship prize the entire course must be traversed three times and the speed must not be over 20 miles an hour.

The course will be L-shaped and will in length be not less than 10 miles nor more than 15 miles. The contests will be brought off between June 1 and September 30, 1904, in St. Louis.

THE LARGEST COTTON MILL.

New England's supremacy as the center of cotton manufacture has been threatened for some time through the establishment of cotton mills in the South, in the region where the raw material is to be had without paying heavy transportation rates. A new development in this industry is the proposition to establish within 20 miles of Kansas City, Mo., the largest cotton mill in the world. From a correspondent, Mr. P. A. Sutermeister, we are able to give the following particulars: Ten million dollars will be invested—$3,100,000 of which has already been subscribed by Eastern and Western men. W. B. Smith Whaley, president of the Olympia and Granby cotton mills, of Columbia, S. C., is to be president and general manager of the enterprise. The mill will have 500,000 spindles and 12,000 looms. It will employ 4,000 operatives and have a payroll of $2,450,000 a year. The capacity of the mills will be 170,000 bales of cotton a year, with an output of 75,000,000 pounds of finished cloth. The value of the output will, it is estimated, amount to $12,750,000 annually. The mill will be of a new type of construction. Electricity will be used as the motive power, and several novel devices will be installed. There are to be four mill buildings, covering an aggregate of 2,000 acres of ground. Power will be furnished from one central plant. It is estimated that it will take four years to erect the proposed buildings. Construction work will begin as soon as five million dollars of the capital stock is subscribed. Among the directors of the new company are Edward Wilder, secretary and treasurer of the Atchison, Topeka & Santa Fe Railway, and A. A. Robinson, president of the Mexican Central Railway.

IMPROVED METHOD OF MAKING TAPS.

An interesting exhibit at the Master Mechanics' Convention held at Saratoga, N. Y., last month, was that of Charles Besly & Co. showing samples of taps made by a new process. The process is in part analogous to that by which the Strange forged twist drill is made, the flutes being forged instead of being milled out of the solid. A tap made by this process is forged from tool steel stock slightly less in diameter than that of the finished tap at the root of the thread. The forging process by which the flutes are formed, expands this portion to the necessary diameter for the thread teeth. After forging, the thread is milled, without annealing, in a special thread milling machine, instead of being chased by a single point tool in the conventional manner. This is both necessary and desirable as it would scarcely be practical to thread a tap in a satisfactory manner, after it has been fluted; and milling the thread is a more rapid and accurate process. The result is a tap that is said to be stronger and tougher than one made by the ordinary process since it is not annealed from start to finish. Considerably less stock is required so that a tap made in this manner costs less for stock and presumably less to manufacture. An important possibility for economy in the case of large users, is that the shanks of long taps that are worn out or broken, may again be used to make new taps having shorter shanks. This the company propose to do, in which case market price will be paid for all long steel shanks returned by customers.

THE NIAGARA FALLS POWER PLANTS.

The new plant of the Niagara Falls Power Co. is so far advanced that it is expected the first generator will be started this month. The new power house is substantially a duplicate of the first one. It is located on the opposite side of the intake canal and nearer to the river, and has turbine wheels placed at the bottom of its own separate wheel pit. The turbines are somewhat different from those in the old station. They are of the internal discharge type and have draft tubes which will increase their efficiency about 10 per cent. The turbines were designed by Escher, Wyss & Co., Zurich, Switzerland, and are being built by the I. P. Morris Co., Philadelphia. The governors are by the same designers and are being made by A. Falkenau, of the same city. The electrical generators are of 5000 horse power each, built by the General Electric Co., and are wound for the same voltage as those in the other power house, so as to interchange with them should occasion require. Much closer regulation is to be obtained than in the old plant, and there are various improvements in the electrical apparatus as well.

The voltage of the lines running from the present Niagara Falls power plant is 20,000, and this will also be used for the new one; but for the Toronto line to run from the new plant of the Canadian Niagara Power Co. a voltage of 60,000 is to be used. Current at this pressure is frightful to contemplate, when one contrasts it with the low voltages commonly employed. The length of the Toronto line is about 90 miles

and the high voltage is necessary for economical results at such a great distance. At most of the large water power plants of California, for electric generation, considerably lower voltages are employed than at Niagara, though in a few instances the pressure carried is higher than used for the Buffalo line. The Bay Counties Power Co. have at least two lines of 40,000 volts and the Mt. Whitney Power Co. are preparing to use over 30,000 volts.

REMOVAL OF THE HISTORIC JORDAN L. MOTT WORKS.

It is announced that the Jordan L. Mott Iron Works are to be removed from Mott Haven, N. Y., near New York City, to Trenton, N. J. The new shops will be located on a large tract of land in the southern part of the city and seven buildings in all will be erected, at a cost of about $1,000,000. The erection of the power house is to begin this month and the other buildings will be constructed as rapidly as possible. This concern employs over 2000 men and will make a valuable addition to the business interests of Trenton.

The Jordan L. Mott Iron Works are one of the historically famous concerns of the country. Their founder, Jordan L. Mott, was born in 1798 and was in a large measure, responsible for the introduction and successful use of anthracite coal. In 1820 only a small quantity of this coal was mined, and it was deemed almost impossible to make a fire with it. Mr. Mott concluded that the difficulty was in using too large lumps of the coal and discovered that by starting with a brisk wood fire on which small pieces of coal were placed, and in an enclosed stove which would produce a strong draft, it might be burned successfully. He made a careful study of the subject of combustion, drawing correct conclusions about the proportions that should exist between size of coal, depth of fire, etc. He invented a stove to burn small coal and started to manufacture it in a foundry which he built near the residence of Washington Irving on the Hudson. In compliment to the noted author it was called the Irving Iron Foundry and was established about 1835.

On account of difficulties in obtaining title to the property Mr. Mott removed his works to a point near the Harlem Bridge and the settlement which grew up round them was given the name of Mott Haven. Since the establishment of these works their line of manufacture has broadened until it includes ornamental and architectural iron work of almost every description, plumbers' goods, etc.

OBITUARY NOTES.

Charles T. Child, late editor of the *Electrical Review*, New York, died on June 23, aged 35 years. Mr. Child was graduated from Johns Hopkins University and at an early age entered the field of electrical engineering. He was first employed by the Sprague Electric Co. and assisted in the building of the first electric railway in Richmond, Va. Later he became a member of the staff at the Smithsonian Institute, Washington, where he remained until he took up the editorial work on the *Electrical Review*, which position he held until his death.

Prof. John Butler Johnson, dean of the College of Engineering, University of Wisconsin, met with an accident on June 23 that caused his death. Prof. Johnson was driving in the vicinity of his summer home at Pier Cove, Mich., when he fell from the carriage and was crushed under its wheels. He was a graduate of the University of Michigan in 1878. Later he became associated with the Washington University, St. Louis, as instructor in civil engineering, which post he held for a number of years until he finally was offered the professorship at the University of Wisconsin. Prof. Johnson was a man prominent in technical circles, a member of a large number of engineering and other societies and had been very successful in the building up of the department of engineering with which he was connected. He was the author of a number of technical and scientific books, chief among which are considered his "Theory and Practice of Surveying" and "Modern Framed Structures." He was also the author of "Materials of Construction," which has been widely circulated, and had also contributed extensively to the "Journal of the Association of Engineering Societies."

STEADYREST DESIGNED FOR LARGE STONE LATHE.

In the April, 1901, issue a large lathe for turning granite columns was described at some length. It was built in Philadelphia by the Philadelphia Roll & Machine Co. for the Bodwell Granite Co., Vinalhaven, Me., and was primarily designed to turn the granite columns for the new cathedral St. John the Divine now building on Morningside Heights, New York City. The largest columns for this great cathedral were intended to be monoliths 54 feet in height and 6 feet in diameter, each having a weight of nearly 140 tons. The immensity of the lathe and the work to be done by it, naturally excited considerable attention.

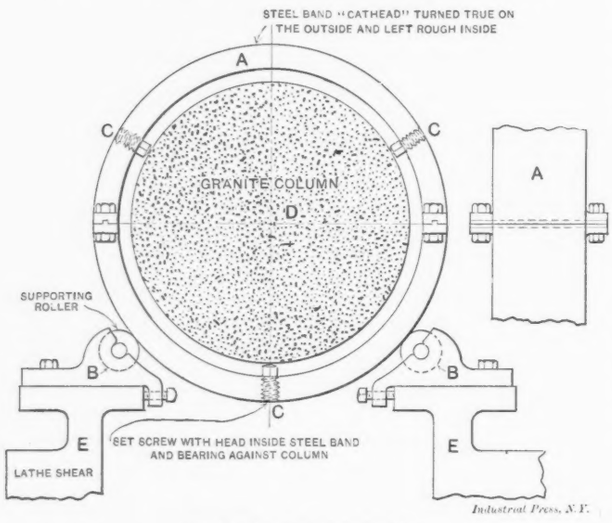
The lathe was built to have a maximum capacity of 60 feet between the headstock and tailstock chucks and to turn a maximum diameter of 6 feet 6 inches. Its total length was 86 feet and weight complete about 135 tons. Revolving chucks of special design were provided at both the headstock and tailstock for supporting the granite columns, but aside from these a column was to be turned and polished with no other supports, there being no intermediate support whatever supplied. This feature gave ground for some criticism which in the light of after events proved to have been well founded. Although the quality of granite quarried at Vinalhaven is of extraordinary strength and is quite free from seams and flaws, columns of such great length, having no intermediate support, could not withstand the operations of turning and polishing without breaking in two. Consequently after a number had been broken in the lathe, the original design of column was abandoned for one made up of two parts, each about 27 feet long. While a column made in two or even six parts would probably satisfy all practical and, possibly, aesthetic requirements, there is a certain sense of disappointment, in mechanical circles at least, that the original design of making them in one piece, was not carried out. It is regarded as somewhat of a reflection on the mechanical skill and ingenuity of the country that it was not done after a special lathe had been built and so much expense incurred.

What puzzles many mechanics is that a steadyrest of substantial design was not provided as an intermediate support when the lathe was built. In fact, two should have properly been made for such a great length. No good mechanic would attempt to turn a steel shaft of such dimensions supported at the ends alone if it could be avoided. Not that it could not be done, of course, but because it would not be good practice. Unnecessary stresses would be imposed on both the lathe and the work. It should be mentioned that the company building the lathe had no part in its design, neither were they asked to submit a design for a steadyrest, nor were they consulted regarding it when the impossibility of turning and polishing full-length columns was discovered, so no blame attaches to them in the matter. A gentleman who was closely connected with the building of the lathe upon being interviewed on the subject, said substantially in part:

"The length of the proposed large granite columns is not in good proportion to their diameter when it comes to having sufficient strength to stand turning and polishing in a lathe. Shorter columns, say, 20 feet in length, are successfully turned and polished at Vinalhaven, down to a certain diameter without intermediate support; but the proportion does not hold good for larger columns, which probably partially explains the error made in assuming that the large columns could be turned without one. The vibration during turning of the large columns when in the rough was excessive, being plainly noticeable to the eye and more pronounced to the touch. The turning tools, which are rotary disks, do not steady the stone, although operating on both sides. Slow rotation does not help matters. The rough stone is not perfectly balanced when chucked, which also makes it bad. The principal trouble was met in polishing. If the polishing iron is carried too low, or if the pressure is a little too much, the stone will climb in spite of its great weight, particularly in the center. The same conditions that make turning long shafts without a steadyrest difficult, also apply to granite columns, with the difference that if a certain degree of deflection is exceeded, the stone will break.

"A steadyrest was designed and built in South Boston, but

from what I can learn its use did more harm than good. The first column it was tried on broke before it had made one revolution, which quite plainly shows to my mind that its design was defective. Another scheme was tried by the granite company that astonished me. They hooked another engine onto the tailstock chuck independent of the main engine driving the headstock end. The column lasted about one-half hour with this scheme. Perhaps if both the headstock and tailstock chucks had been geared to the same shaft so that they could be driven in unison from one engine and a suitable steadyrest with a 'cat-head' had been provided, the columns could have been turned and polished without breaking. The accompanying cut shows a design of a steadyrest which, I think, would have served the purpose all right.



Steady Rest for Stone Lathe.

"A steel band 'cat-head' *A* would be required, that is, made in two parts. Lugs or ears are provided at the sides for the connecting bolts, which would have to be placed in this position so as not to interfere with the supporting rollers *B B*. The joints of the steel band should be tongued and grooved so as to keep the ends in perfect alignment. Two rows of setscrews are required with the square heads on the inside to bear on the column. These screws should, of course, not project beyond the outer surface of the band. When this 'cat-head' is set concentric with the axis of the stone and the rollers are brought to properly support it, there would be little if any chance for deflection. Probably two steadyrests would be required on a 54-foot column. A third roller could be placed directly beneath the center of the stone between those shown, if it was thought necessary. To make the rollers turn easily when supporting the great weight, they might be provided with roller bearings."

* * *

HIGH GRADE STEEL FORGINGS IN AMERICA.

Few people are probably aware of the important change that has taken place in machine construction in this country as a direct result of the improvements in the manufacture and forging of crucible cast steel, first introduced by the Bethlehem Steel Co. Without these improvements the large power units now used in electric generating stations would have been impossible, for no forgings could have been obtained that would have been able to sustain the tremendous strains of such machinery. When steel forgings were first employed for large work they were generally considered inferior to iron forgings, because, as is well known, steel is not as easily forged as iron and is more easily injured in the process, while the methods used in forging were not adapted to the requirements of the new material. The improvements in the manufacture of steel came through the efforts of the government to obtain steel suitable for large guns and the parts of marine engines, which, according to law, had to be built in this country, and of American material. A brief history of how the change from iron forgings to high-grade steel forgings came about is told interestingly by H. J. Porter in a paper read before the recent meeting of the Engine Builders' Association. That part of his address referring to this historical point is given below.

At the time that George H. Corliss built his Centennial engine he had his own smithshop in which his shafts and other engine forgings were built up out of small faggots of wrought iron. This was about the time when steel began to encroach upon iron in the trades. Before this time wrought iron was a staple article in the market. The quality of this material, coming from the rolling mills, was very high, demands for high grades having brought about methods of production which supplied the trades with double and extra refined iron, very free from slag and dirt. The small forges sparsely scattered about the country were equipped with hammers of 10 tons falling weight with top steam, sufficient in capacity to thoroughly work and weld together the few small faggots of iron which were required to build up the moderate sized forgings which the various industries demanded. When steel made its appearance, however, manufacturers generally began to appreciate the fact that the market contained a new material, stronger and more reliable than wrought iron. Desirous of having the forged parts of their mechanisms smaller and lighter, they attempted at once to obtain forgings made of this metal. Had the forges made proper efforts to acquaint themselves with the nature of this new material before attempting to supply it, a very different condition of affairs would have come about, not only in the forging industry, but in the steel industry at large, than that which resulted from the first unintelligent effort at production. At a meeting of the Railway Master Mechanics and Master Car Builders at Old Point Comfort in 1899, Captain (now Admiral) Robley D. Evans delivered an address in which he said:

"In 1882 I had the good fortune to be ordered as a member of what is known as the first advisory board for rebuilding the navy. It was an awfully hot summer, and 15 of us rather impatient spirits got together in Washington, presided over by Admiral John Rodgers. When we looked the field over, we found that we had no navy at all; we were hopelessly behind the age, and it seemed hardly worth while to rebuild our navy. I shall never forget as long as I live the trouble I caused in that small convention by proposing that we should build steel ships. I was the original steel man, and when I proposed that all ships in the future should be built of steel, Admiral Rodgers adjourned the board for three weeks to prevent a fight."

Now the animus referred to by Admiral Evans was induced by the fact that forgings which were being supplied at this time were of just such a type as might be expected to be produced by men who had not acquainted themselves with the requirements of the new material. While some were excellent in every way, others were deficient in strength, or contained concealed cavities and were unreliable in general. The supply of material running so irregular in quality reflected unfavorably upon the steel industry at large and developed a prejudice against steel generally, from which it has scarcely recovered in the minds of many users of forgings, even at the present day. It was fortunate for the country that the advisory board referred to contained as stalwart a champion of steel as Admiral Evans, for after they had visited the various ordnance works abroad and had seen steel worked properly, they returned home and recommended to the Secretary of the Navy, Mr. Tracy, that by all means the new navy should be built of this metal, and as there were no properly equipped steel forges in this country, one would have to be built to furnish the necessary armor, guns and engine forgings required in the construction of modern naval war vessels. Meanwhile, this board had overcome, through the good offices of its secretary, the personal objections heretofore existing on the part of Sir Joseph Whitworth to the use of his special steel casting and forging presses elsewhere than in his own works, which were considered foremost in the manufacture of ordnance. Without entering into the details which accompanied the immediate establishment in this country of the great ordnance works of the Bethlehem Steel Co., it is sufficient to say that in their equipment not only were the special appliances in use in this

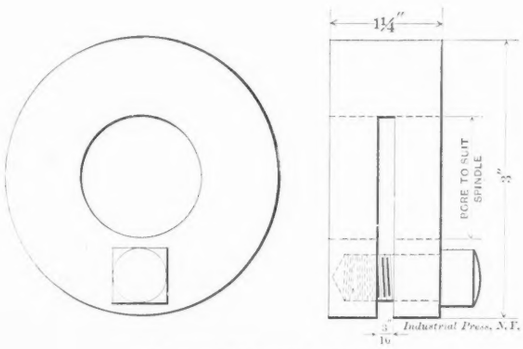
English works duplicated, but their size was doubled. A contract was also entered into at the same time by which the great works of Schneider & Co., of Le Creusot, France, which stood first among the makers of armor plate, were also duplicated at the Bethlehem plant. Thus there arose in this country a forging plant at once larger and superior to any in the world.

During the years that this plant was being erected there were many engineers who, appreciating the superior advantages of steel forgings, when properly produced, over those made of wrought iron, systematically sent abroad for their steel forgings. It was not until 1889 that the country obtained its first high-grade steel commercial forgings from the Bethlehem works. These had been gladly specified by the engineers above mentioned who were impatiently waiting to get their steel forgings nearer home than in Europe. Machine and tool builders of this country were thus made acquainted for the first time with steel forgings intelligently produced. There are to this day many users of steel forgings who, not having carefully investigated the methods considered necessary to produce them, think that a steel forging is made by merely hammering a rolled steel billet to the form required; and such as ordered their forgings without specifying more definitely the grade called for by the special service to which the forging is to be submitted, may get a forging of that type. The forging industry has grown from the blacksmith shop, a once familiar adjunct to an engine works, and has become a specialty; and a modern steel forge is not now thought complete unless it melts its own raw material and converts it into the finished product under the supervision of chemists, metallurgists, physicists and microscopists.

* * *

STOP COLLAR FOR DRILL SPINDLE.

A writer in *Science and Industry* describes a stop collar he has made and applied to a drill press spindle. After stating that the accompanying sketch is nearly self-explanatory, he says:



Stop Collar for Machine Spindles.

"In many shops the drill presses have no stop on the spindle, and when it is necessary to drill holes a certain depth the cut-and-try method is very often adopted, which, to say the least, is wasteful of time. I have used the collar as sketched with good results when slotted out in the manner shown, and made a nice fit for the drill spindle. The setscrew, upon being tightened, will bind the collar wherever it is placed without in any way injuring the spindle."

* * *

In the July number of MACHINERY Mr. E. R. Markham's address was given as Worcester, Mass., in connection with his contributions. He is a resident of Springfield, Mass., and is instructor of machine shop practice in the Mechanic Arts high school of that city. He is also instructor of machine shop practice and toolmaking in the Evening School of Trades.

* * *

Some men are so impressed with their own knowledge, and so fearful lest they impart knowledge to others, that they fail to even keep up with the procession, much less march in front of the band wagon. These men are very apt to think there is nothing to be learned by reading trade papers. —*The Woodworker.*

ITEMS OF MECHANICAL INTEREST.

TEMPERING SMALL TOOLS—LONG PLUMB LINES DIVERGENT—LOOSE PULLEY DIFFICULTY OVERCOME—SECTION OF A SHEAR—CUTTING LEFT-HAND SCREW WITH RIGHT-HAND TAP, ETC.

The defective welding of wrought iron boiler tubes was recently proved by D. Woodman, of New York, says the *Horseless Age*, by laying sections of each kind of tubes in 10 per cent. of sulphuric acid. The good tubes were attacked uniformly all round, the line of the weld showing merely by its color. The other tubes, however, were eaten away on the line of the weld very rapidly, so that a deep slit was formed there. This indicated that the metal along the weld was porous and open; in other words, that the weld was defective.

Last month we recorded the effort of a professor in the Canary Islands to extract electricity from the atmosphere and so obtain power for nothing. Not to be outdone in this direction an American inventor of Cleveland, O., Henry Soeder by name, and a grocer by profession, has invented a process for "drawing gas from air." A press dispatch names several financial heavyweights who are said to be backing the scheme and says that Soeder threatens to revolutionize the industrial world by literally drawing on the atmosphere for fuel. The prestidigital act is performed by passing air over a mysterious chemical, "a trunkful of which is sufficient to propel an ocean liner from New York to Liverpool" and which is destined to "replace coal in locomotives, gas furnaces and all other industries."

In the May number of MACHINERY appeared a paragraph upon the scientific use of the kinetoscope and it was stated that it was now possible to photograph air currents produced by any sudden movement or even by sound itself. The Philadelphia *Times* recently published a half-tone reproduction from a photograph picturing the flying bullet and showing plainly the disturbance set up in the atmosphere by the bullet. The waves of air dart away from the bullet in straight lines, appearing not unlike the head of an arrow in the photograph. They were obtained on the photographic plate by reason of their density being greater than that of the surrounding air. The extreme sensitiveness of the photographic plate that must be necessary for such rapid work and the extreme rapidity of the shutter of the camera can well be imagined when it is stated that the photograph has no blurred appearance.

A BLACKSMITH'S METHOD OF TEMPERING SMALL TOOLS.

For hardening and tempering taps, knives and small springs, says a writer in the *American Blacksmith*, get a piece of pipe of sufficient diameter and length to accommodate the piece. Heat one end, flatten together on the anvil, and weld so it will not leak. Fill the pipe with lead and set it up in the fire. When the lead has melted, immerse the tool and let it remain until the lead is red hot. Then dip in salt water all over and when cool remove it. To temper the tool, heat a large piece of iron in the forge to a red heat. Grease the tool all over with tallow. Remove the iron from the forge and lay on the anvil. Hold the tool over the hot iron by means of tongs or pliers, turning it all the time until the desired color is obtained and then drop it into linseed oil. A good and uniform temper should result.

LONG STEEL PLUMB LINES DIVERGE WHEN ADJACENT.

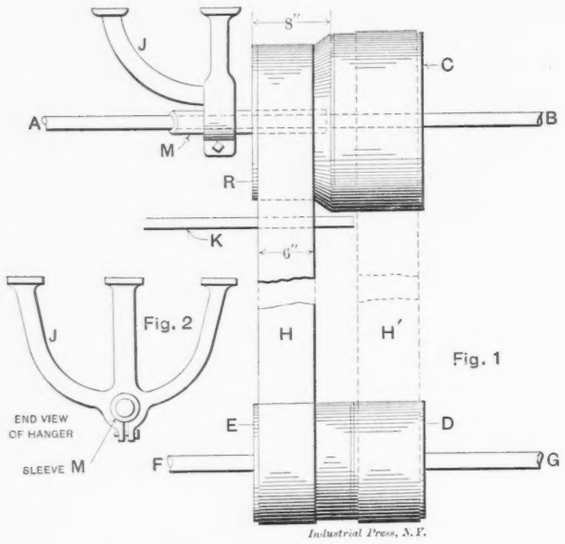
An interesting scientific test was made some time ago at the mines of the Tamarack Mining Co. The mine has a shaft over a mile in depth and in order to connect a point of this shaft with the older works of the mine it became necessary to plumb down two points; and two lines over 4000 feet long, consisting of steel piano wire, carrying 50-pound weights were used. The two plumb lines were about 17 feet apart and it was found on accurate measurement that instead of pointing toward the center of the earth which would make them nearer together at the bottom than at the top, they were farther apart at the bottom than at the top by a little over an inch. The only reasonable explanation was that the wires

became magnetized by the earth's current and that the two lines acted as magnets having similar poles at their lower ends, which repelled each other. This explanation has been substantiated at Columbia University by experiments with lines 75 feet long, which showed similar results.

POWER TRANSMISSION DEVICE.

A correspondent of the *Woodworker* describes a combination of tight and loose pulleys for belt transmission of power from main shafts to countershafts, which overcomes the objection to loose pulleys on main shafts as ordinarily applied for this purpose. A loose pulley on a main shaft that becomes cut or stuck is a serious nuisance as either condition necessitates taking down a section of the shaft to make repairs. While in this combination loose pulleys are employed, they are never in stationary contact with revolving shafts, and as they only turn momentarily on their bearings when starting or stopping a countershaft, there is little or no danger of their ever giving trouble.

In Fig. 1 *A B* is the main driving shaft and *F G* is a countershaft driven by it. Pulley *C* is keyed to the main shaft and pulley *R* is mounted loosely beside it on a sleeve *M*. This sleeve is bored out larger than the shaft and is supported entirely free of it by the three-footed hanger *J*, Figs. 1 and 2, so that the shaft turns in it without friction.



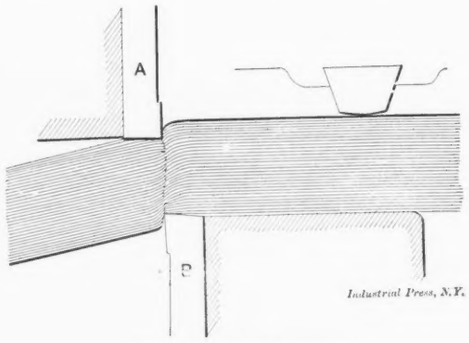
Power Transmission Device.

It will be noted that the belt step or face of pulley *R* is of less diameter than that of *C*, and that the right-hand side is coned to the same diameter as *C*. By this arrangement the driving belt is relieved to tension when not in actual use. The pulley *E*, which has a broad face, is loose on the shaft *F G* and *D* is keyed to it. The belt *H* is shown on the loose pulleys as it is when the countershaft is not running. Movement of the belt shifter *K* to the right forces the pulley *R*, which has a slight longitudinal movement on its sleeve, over against the side of the pulley *C* which is running and because of the frictional contact it begins to turn. The belt now being in motion, it can be easily shifted up over the conical part on the tight pulley *C*. The loose pulley *E* being broader than *R* the belt is shifted on *C* about 2 inches before it begins to encounter the resistance of the tight pulley *D*. Of course when the countershaft is running the loose pulley *E* will run with it as there is no resistance to prevent it and loose pulley *R* will not run, as it will not be in frictional contact with any revolving parts.

THE ACTION OF A SHEAR IN CUTTING A THICK BAR.

The London *Engineer* in a recent issue described at some length the action of a shear when cutting through a thick bar of metal. The action referred to is, of course, well known to almost everyone who has critically watched the work of a shear, but perhaps it gains an added significance after having appeared in the columns of this somewhat ponderous yet really excellent publication.

"The diagram illustrates the operation at the moment preceding the complete separation of the bar. A is the moving steeling attached to the slide, *B* is the fixed steeling attached to the anvil. As the moving steeling advances towards the fixed steeling, the bloom is compressed between the two until each steeling has made an imprint on the bloom. In making this imprint it cuts its way about ½ inch deep through the

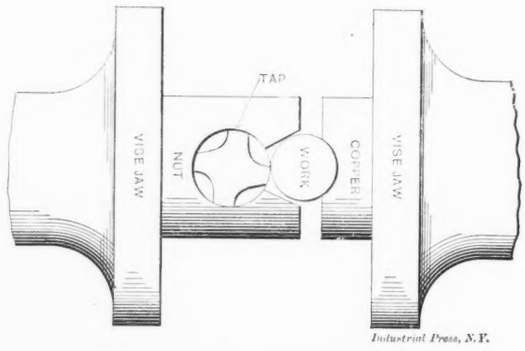


Action of a Shear Illustrated.

fibers of the bloom, and owing to the great distortion of the fibers flowing under the compression of the base of the steelings, a crack is set up in advance of the ½ inch, which is veritably sheared by the steelings. From this point no more cutting is done by the steelings, but the pressure from the two opposite sides compels the fibers of the bloom to yield, as shown by the dotted line, without the edges of the steelings themselves ever coming in contact with the ruptured section. The diagram has been taken from an actual experiment in which the machine was run at such a speed as to pull up when it was at the stage of the cut shown on the diagram, and the dotted line on the diagram is taken from other specimens in which the cut was completed. The sketch is reduced from a section laid down to full size."

CUTTING A LEFT-HAND SCREW WITH A RIGHT-HAND TAP

A correspondent of the *American Blacksmith* gives an old, but rarely used method of cutting a left-hand screw by means of a right-hand tap. Take a right-hand tap of the desired number of threads per inch and run it into a square nut hard and fast. Then screw it out of the nut and cut a V in the nut so that one flute of the tap will project into the V far enough to cut a full depth thread on the bolt; the larger the diameter of the bolt, the larger must the V be cut. Now screw the tap into the nut with one flute projecting into

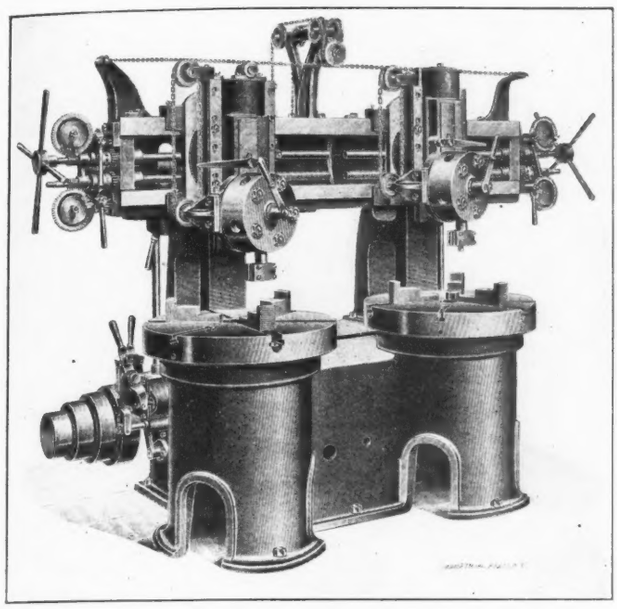


Cutting a Left-hand Screw with a Right-hand Tap.

the V, as shown in the cut, and turn it upside down in the vise with a piece of copper or other soft metal between the bolt and the other vise jaw. Turn the bolt to be threaded to the left and a passable left-hand will be produced. Care must be taken not to let the flute of the tap project too far into the V, as in that case a piece is likely to be broken out of the tap. Copper or other soft metal must be placed between the work and the vise jaw so as to avoid spoiling the thread, as considerable pressure is necessary to cut the thread.

ENGLISH DOUBLE BORING MILL.

The London *Engineer* says that one of the advantages of the boring mill over the lathe is the possibility of making it duplex or even multiplex. While lathes are sometimes made double the boring mill is more readily adapted to the multiple design. The one shown is a duplex machine made



Double Boring Mill of English Design.

by Webster & Bennett, Coventry, and is, of course, intended to be run by one operator. The table chucks are 30 inches in diameter and have sixteen speeds. The feeds of the two turrets are entirely independent, as are the speeds of the work tables. Height from table to turret, 22 inches. The weight of the tool is about 9,000 pounds.

VARIABLE FEED DEVICE FOR MACHINE TOOLS.

A variable feed device for lathes, recently patented by W. F. & John Barnes Co., is shown in the cuts Figs. 1 and 2. By this device the longitudinal and cross feeds may be

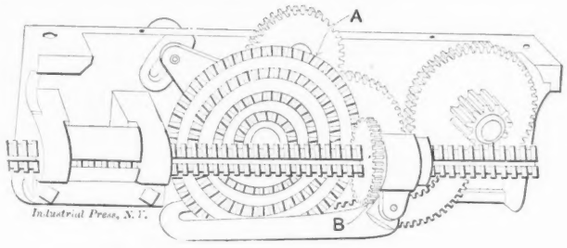


Fig. 1. Showing Face of Multiple Crown Gear.

changed from coarse to fine or vice versa, the graduation being in four steps. By it the feed may also be reversed and in the reverse position the same graduations may be obtained.

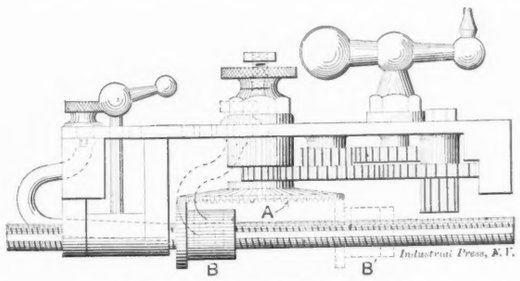
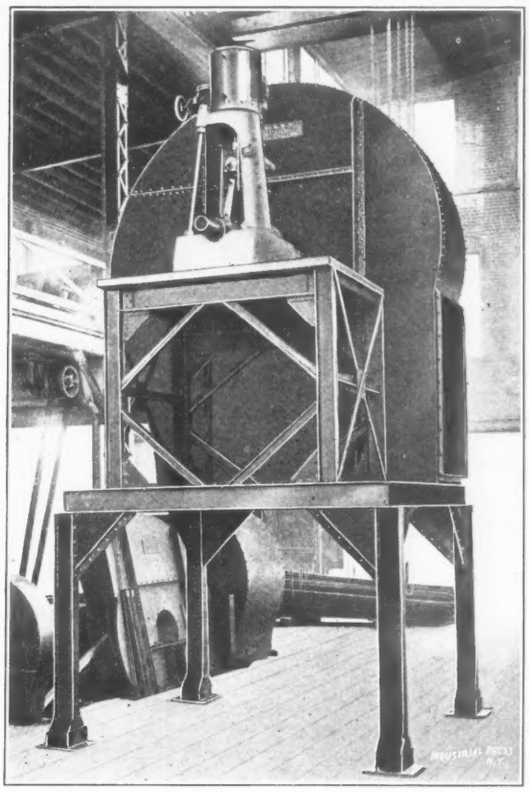


Fig. 2. Plan View of Variable Feed.

This effect is obtained by having a crown gear *A* with four concentric rows of double-wedge shaped teeth, with any of which the spur tooth pinion *B* may be engaged. The position of *B* relative to *A* determines the velocity ratio and also the direction of the feed. The position of *B* in Fig. 1 will give the same pitch of feed as that in Fig. 2, but in opposite direction. The fine feed position is obviously that in which the spur gear engages with the inner row of teeth on *A*. The pinion is shifted longitudinally on the lead screw by means of a lever projecting through a slot in the lathe apron; and notches are provided along the bottom of the slot to hold the lever in place when it has been set. The changing of the feed or its reversal is accomplished by the practically instantaneous movement of the lever which is at the operator's hand.

FAN BLOWER FOR THE WEST POINT MILITARY ACADEMY

The accompanying illustration shows the induced draft outfit which the American Blower Co., Detroit, Mich., are installing at the West Point Military Academy. The fan is 160 inches, of the full-housed type, operated by one of the American Blower Co.'s new vertical direct-connected marine



Induced Draft Outfit of New Design.

type engines, having a 12-inch cylinder and 10-inch stroke. This engine is supported by a steel pedestal 6 feet high, the whole apparatus being mounted upon a steel pedestal 12 feet in height. This apparatus is connected with a battery of six 60 foot x 16 foot boilers, and it is estimated will produce at least a one-third increase in efficiency.

SOLDER FOR ALUMINUM.

A great drawback to the use of aluminum for many purposes is the difficulty of soldering it. A number of solders are known that are fairly successful when manipulated by skillful hands. The following one given in a recent issue of the *Aluminum World* is presumably of the same class, and is given for what it is worth. It was recommended by Prof. E. Wilson in a paper read before the Society of Arts. The constituents are 28 pounds block-tin, 3.5 pounds lead, 7 pounds spelter, and 14 pounds phosphor-tin. The phosphor-tin should contain 10 per cent phosphorus. The following instructions should be followed when soldering aluminum: Clean off all dirt and grease from the surface of the metal with benzine, apply the solder with a copper bit, and when the molten solder covers the surface of the metal, scratch through the solder with a wire brush, by which means the oxide is broken and taken up. Quick manipulation is necessary.

LETTERS UPON PRACTICAL SUBJECTS.

SOLID DIES OF STANDARD NUT SIZE FOR CHASING JAMMED THREADS.

Editor MACHINERY:

On repair work it is very often necessary to run a die over the threads of studs that have become jammed, otherwise it would not be possible to screw the nuts on them again when the work was being erected. If a die can be run on a jammed stud while it is in position the trouble of removing it is avoided. The usual result of trying to unscrew a stud that has been in place for some time is that it either twists off or is badly damaged, so that in either case a new one is required to replace it. In case it twists off a job of ratchet drilling is in order. This being the condition of affairs, the desirability of a die than can be used in close places for straightening up the threads of jammed studs is constantly apparent to the machinist having this class of work to do. Sometimes in a pinch a casehardened nut is used, but this can only be done when the damage to the thread is slight.

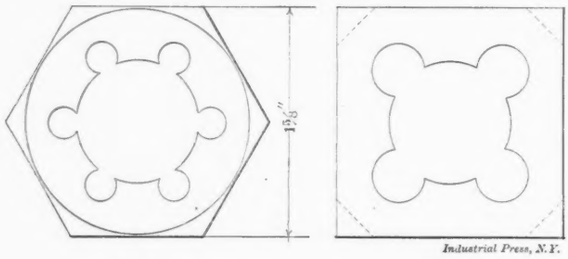


Fig. 1. Fig. 2.

So far as I know there is nothing on the market that can be used in close places except the solid square dies made by a number of tap and die manufacturers, which are of the same style as the ordinary square pipe thread dies. These usually being about 2½ inches square for standard screw threads up to 1¼ inches, require a circle of at least 3½ inches diameter to turn. When the available space is less than this, these dies, of course, cannot be used. But if solid dies of standard nut size were made for such work they could be used to chase a bruised or rusty thread or any stud no matter how located, provided, of course, there is room for a standard nut to turn. Two suggestions are offered in Figs. 1 and 2 for dies that would fill the bill. Fig. 1 is a hexagon die having six clearance holes drilled on the three diagonals, and consequently six chasers. The die shown is 1⅝ inches across flats, which is the same as a standard 1-inch nut. The die shown in Fig. 2 is made square and the corners are cut off as indicated by the dotted lines so that it can turn in the same circle as Fig. 1. This die would not be so attractive in appearance as the hexagon die, but the clearing holes could be made somewhat larger than those in Fig. 1 and still have the same thickness of metal between it and the outside edges. Both forms should be at least one-fourth thicker than the diameter of the screw for which each is made, that is, a die for a 1-inch screw should be about 1¼ inches thick. Of course it will be understood from the foregoing that these dies are designed to be used entirely for chasing jammed or rusty threads and *not* for cutting new threads.

Newark, N. J. F. EMERSON.

HEIGHT OF LATHE TOOLS—RAKE ON CUTTING-OFF TOOLS—FORMULAS, ETC.

Editor MACHINERY:

It is customary when turning work in the lathe for workmen to set the lathe tool above the center, except when turning tapers or cutting screws, and even when threading work many prefer to set the tool above the center, the variation of angle of thread not being noticeable for a short distance above the center, and if the tool has the proper clearance the work may be smoother as a consequence. If a workman is asked why he sets the tool above the center he usually replies that the tool cuts smoother and lasts longer; he may not know just why, but is quite sure that it does. It has been a problem to me why this is so, and I do not claim to have fully solved it yet; but I have a few ideas to offer, and if some other reader of MACHINERY has some also and will send them to the editor they may be of interest and nothing will be lost in discussing the action of cutting tools so as to determine under what conditions they give the best service.

It would seem at first better to set the tool the same height as the lathe center, as in that case the tool would not need so much clearance and therefore might last longer. It would also seem that if the tool was set above the center any spring of the tool downward would cause it to dig into the work. But for many cases the work is likely to spring more than the tool, especially if the work is of small diameter, and if the tool is set level with the center the work may spring up and the tool down, so that after the cut is started the tool is really cutting below the center, and when this occurs there is a chance of the tool prying the work from the centers, causing the workman a disagreeable surprise. When the tool is set above the center as in Fig. 1 it needs to have more clearance than if set on the center as in Fig. 2, as the cutting edge should penetrate the metal the deepest.

It is obvious that the work is not as likely to spring up from the pressure or resistance of the chip in Fig. 1 as in Fig. 2; also when the tool is above the center it enters the work more like a wedge, requiring less power to drive it. If the tool is set below the center it would have a tendency to rip or scrape the metal off. When cutting off stock of large size in the lathe it is well to set the tool above the center even if it is necessary to reset the tool when approaching the center, as the tool is not so liable to dig into the work. When cutting wrought iron or steel the tool should have plenty of top rake as in Fig. 3.

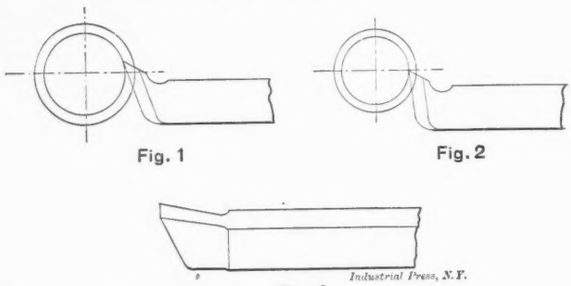


Fig. 1 Fig. 2

Fig. 3

Illustrating Setting and Rake of Lathe Tools.

When making calculations regarding speeds of pulleys, gears, etc., many mechanics take the longest way because they are not accustomed to using formulas. In Mr. Peker's contribution in the June issue will be found some good points to be remembered about using formulas, such as substituting some easily remembered numbers for the letters and working out trial examples to prove if the process is correct.

Take, for example, the rule for calculating the speeds of pulleys: *The diameter of the driver times its number of revolutions equals the diameter of the driven pulley times its number of revolutions.*

Let D = diameter of driver,
Let R = number of revolutions of driver.
Let r = number of revolutions of driven pulley.
Let d = diameter of driven pulley.

Then $D \times R = d \times r$.

The sign of multiplication is usually omitted in formulas, so we have D R = d r.

Now this formula represents an equation; therefore if we multiply or divide both sides of the equation by any quantity the result would still be an equation, and we can by this process obtain the value of any one of the quantities in the equation if the other three are known. For example, to find the value of d: Divide both sides of the equation by r and (as the r's cancel in one side of the equation) we get $d = \frac{D R}{r}$

This would give the diameter of the driven pulley to make a

number of revolutions per minute. To be more exact, the thickness of the belt should be subtracted from the result, as the diameter of the pulleys should be calculated to the center of the belt. The same method of procedure would give the value of any other quantity in the formula. For example: The driving shaft has a 12-inch pulley and makes 120 revolutions per minute. What should be the diameter of the pulley on the driven shaft to make 80 revolutions per minute? Neglecting the thickness of belt:

$$d = \frac{D \times R}{r} = \frac{12 \times 120}{80} = 18'' \text{ Ans.}$$

East Providence, R. I. J. T. GIDDINGS.

"THEORY AND PRACTICE."

Editor MACHINERY:

Friction is perhaps the most elusive factor in machine design. There are in theory certain well-defined laws, but in practice these laws must be applied with a great deal of judgment and with many allowances. I suppose most people have been surprised when they first learned that friction was not in proportion to the amount of surface in contact; that it was in fact quite independent of area or velocity.

In the July issue of MACHINERY "W." quotes a paradox which seems at first sight to disprove this law. As I understand him there is a small shaft with a center hole in one end reamed deeper than at the other end. When this is placed in the lathe so that the live center enters the deep hole the piece revolves, inferentially because there is more area of surface in contact with the live center than with the dead center. As if to still further prove this argument, the piece when reversed remains stationary, there being then more area in contact with the dead center than with the live or driving center. This argument which at first seems so convincing proves on examination to be superficial, since there

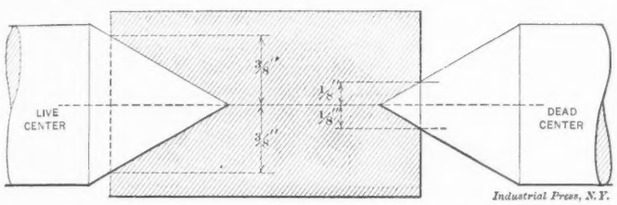


Diagram Illustrating Difference in Frictional Resistance of Large and Small Bearings.

are other elements to be considered. The deeper the hole is reamed the larger it is, and the lathe center will take a bearing further away from the center line of the shaft. The further away from the center it is the more leverage or "purchase" it will have, consequently if one hole is three times as large as the other, as shown in the sketch, the same friction will have three times the value at the large end. If the live center is inserted in the large hole the friction will cause it to turn because it is exerted three times as far away from the center line as the same friction on the dead center which tends to retard the motion. This would explain the phenomena which "W." describes without violating the law of friction which he quotes. PRACTICE.

CAUSE OF OLD LATHES BORING TAPER HOLES.

Editor MACHINERY:

It is so well known as to render comment unnecessary that most old lathes bore taper holes when an ordinary hook tool is used, but many machinists fail to understand that they have within easy reach a method of controlling the defect so that very often difficulties can be overcome that would otherwise be very troublesome even if not such as to spoil the work.

The cause of a lathe boring taper is usually due mainly to the great wear on the chuck end of the live spindle, the weight of chuck and work wearing this end low.

In Fig. 1 the top of the lathe bed is represented by the line *A A*, the center line of spindle by *B B*, showing the faceplate end very much lower than it ever would be, of course. The exaggeration is necessary to make the drawing clear. It represents the work, and the tool is shown at *T* which is supposed to be an ordinary hook tool. No other parts need be shown; the work may be regarded as held in a chuck or in any convenient way. The tool *T* travels on line *C C* parallel to the bed *A A*, but not parallel to the center line *B B* of the spindle in the horizontal plane. It is, however, parallel to *B B* in the vertical plane, as shown in the plan view above.

Let us suppose that the tool enters the hole at the same height above the bed as the center of the front end of the hole. As it moves along line *C C* it will reach such points as *T'* and *T''*, and though its distance sideways from the center line *B B* remains the same the real distance increases as the distance between the point of the tool and line *B B* increases. The diameter of the hole bored therefore increases. This is shown in section *x x* and *y y* taken halfway through the hole, and just before the tool runs out.

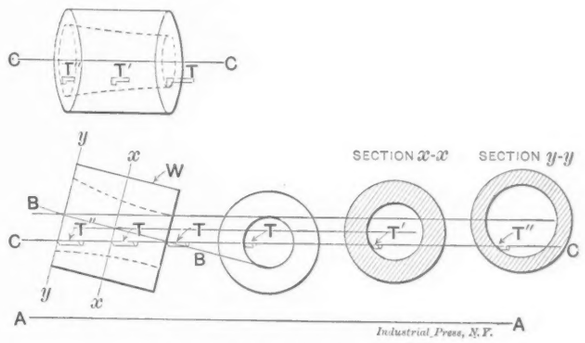


Fig. 1. Lathe Boring Large at Back.

Now taking the distances from the center of the hole to *T*, *T'* and *T''* in the end view and cross-sections of *W* and laying them off each side of *B B*, as shown in the side view, at the distances through the hole at which these views are taken, we get points in the piece *W* through which the tool has passed, and if we draw lines connecting these points we get the true shape of the hole which we find to be bell-shaped and largest on the back end and smallest on the front end.

Now let us take the tool as shown in Fig. 2, in which it enters the work at such a height that when it reaches the back end of the hole it will be on a level with the center line *B B*. We now find conditions just reversed and a bell-shaped hole large on the front end is the result. The same reference letters apply to Fig. 2 as to Fig. 1.

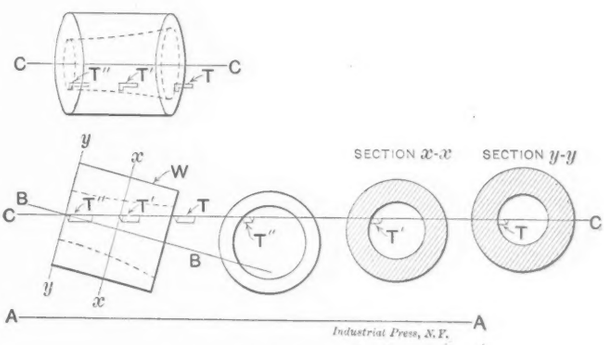


Fig. 2. Lathe Boring Large at Front.

If the tool were made to come to the level of the center line as it reached the middle of the hole the result would be a combination of Fig. 1 and Fig. 2, or a hole bell-mouthed at both ends.

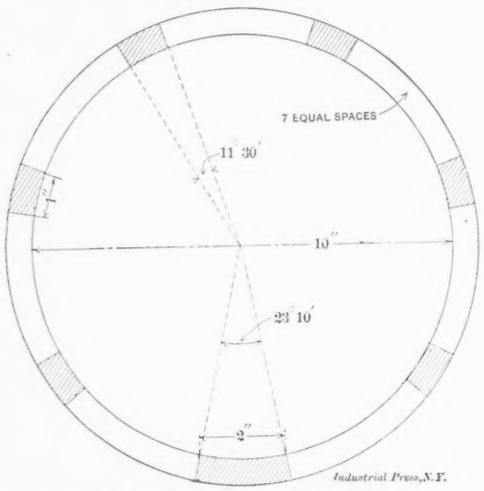
Enough has been said to show that when the faceplate end of the spindle is low it is only necessary to raise the tool above the center to bore large on the front end when the work is held by chuck or faceplate. But it must be borne in mind that this does not apply to work which is steady-rested, for the work may be raised above or depressed below the center line of the lathe at the steady-rest end, and effects produced opposite to or the same as here shown, according to whether the work is high or low. F. M. B.

Hartford, Conn.

DIVIDING CIRCLES WITH UNEQUAL PARTITIONS.

Editor MACHINERY:

The accompanying cut represents in cross section a casting that was divided, as shown, into seven equal spaces, but one of the partitions measured 2 inches for its chordal length inside, while the rest measured 1 inch. It will be seen that it is more difficult to lay out such a piece than it would if all the partitions as well as the spaces were equal. I asked one or two men who occupy responsible positions how they would go to work to space it as required, but they did not give very satisfactory answers. It may be that some of your readers would be interested if I gave my way of doing it.



Dividing Circles having Unequal Partitions.

First, I found what angle was embraced by the 2-inch piece, which was 23° 10′; also the angle of one of the small ones, which was 11° 30′. The sum of the six small divisions and that of the larger made a total of 92° 10′. That number subtracted from 360° left 267° 50′, to be divided by seven, which gave 38° 16′ as the angle of each space. The question may be asked how I found the angles. Well, not having a protractor handy, which would be the quickest way of finding them, I found them by trigonometry, *i. e.*, by taking one-half of the chord as a dividend and the radius of the circle 5″ as a divisor. The quotient gave the sine of one-half the angle. Then by turning to a table of sines (given in any engineer's handbook) and noticing the number of degrees opposite the number thus found the angle for one-half the chord was found. This angle multiplied by two gave the angles as shown on the drawing.

Now a word to those who do not understand the method here described. I advise them to proceed as follows: Draw the 10-inch circle, set the dividers to the chord of the 1-inch partitions and step off six such spaces, then add the 2-inch space. By so doing the whole number are grouped together. Then divide the remainder of the circle into seven equal parts, which can be done by trial in a short time.

I was in an office to-day and saw a sample copy of MACHINERY lying on the desk. I asked a foreman of machines if he took the paper. His answer was "No," and he gave as a reason: "That kind of papers contains so much algebra and trigonometry that if a man knew all such matter he would have no business working in a machine shop, as he could do much better at something else." Comment is unnecessary.

Oneonta, N. Y. WM. NEWTON.

SOME DRAFTING ROOM KINKS FROM CHINA.

Editor MACHINERY:

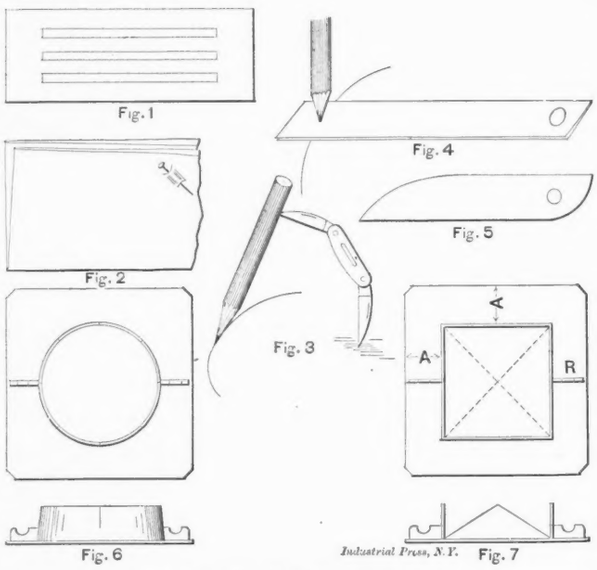
Every draftsman knows by experience what a tedious job it is—and the more so on large scale drawings—to do the "hatching up" of broad sections. A very convenient way to obviate this is to use a red pencil, and do the hatching free hand on the "back" of the tracing. After a little practice one is able to draw and space the lines quite regularly, but, of course, they are thicker and farther apart than when made with pen and ink. Besides much time saved and bother avoided, it gives the blueprint a very neat appearance, and when an alteration is wanted on the tracing, figures and lines can be rubbed out just where needed, without disturbing the surrounding hatching, thereby saving the trouble of patching up and also leaving the tracing cleaner.

For rubbing out lines on tracings or ink drawings exactly where you wish to, take an ordinary visiting card, as in Fig. 1, and with two strokes of the knife cut a slit in it about 1-32 inch wide; lay it upon the line to scratch out and go over with the eraser. This makes a quick and clean job. When the slit gets too wide a new one is soon made alongside. Still better than a card is a strip of very thin brass or copper; it lasts much longer and takes little room in the draftsman's drawer.

A very simple mixture for altering a blueprint or patching up a badly printed one is a liquor made of soft green soap diluted in six to ten times its weight of rain water. The proportion varies with the quality of the soap. Care must be taken not to put too much in the pen, so as to avoid blotches.

If the section lining has been forgotten on some part of the tracing or if for any other reason a shade is desired on a blueprint, use some "white silver" water color, in cake, diluted in a little water and apply with a soft brush. Its chemical action upon the "blue" produces a purple tint, which appears well only when dry. Very little color is needed to obtain the desired effect.

In a case of emergency, whether in the engine room or drafting office, one may at times need a straightedge and a "triangle" with a pair of dividers or trammels. A sheet of strong paper will enable one to procure the whole kit in a few minutes. To begin with the "triangle" (see Fig. 2), fold the sheet first in two and go over the crease with the fingernail or the handle of your knife so as to obtain a sharp edge. Then fold up again the edge on itself, being careful to have both parts coincide exactly. Stick a pin through the open corners, and your "triangle" is just as accurate as a $2 one. For a pair of dividers a lead pencil and a double-end penknife are the only material required. Stick one of the blades into the pencil, using the other as a pivot, and "there you are." Of course, the pivot blade must bear a sharp point, as in Fig. 3.



Some Drafting Expedients.

If instead a large circle is to be drawn, then a beam compass, like that in Fig. 4, is manufactured in a few seconds. A strip of paper somewhat longer than the required radius of, say, 2 or 3 inches in width, is doubled up in two or three folds. You have thus a strip one inch wide, on the middle of which draw a center line. Now plot out on same the radius of your circle; through one of the dots insert anything in the shape of a tack or pin; introduce into the other the tip of a sharp pointed pencil and go round. If the beam (!) of your trammels has been folded with enough care the edge well creased, as for the "triangle," will be straight enough to draw as many lines as wanted—that is the straightedge.

With the aid of the four above patented (?) instruments one is able to make very acceptable sketches. Though I do

not claim the "patent" I have thought they might be of some help to others, as they have been to me.

A complete and costly set of curve patterns can be replaced at small expense if any, and with most advantage by those shown in Fig. 5. Together with true curves drawn with compasses they meet all requirements of machine designing, and after personal experience I can say to a better extent than the former. Ever since I had them made several years ago I have always found them quite convenient and handy. They are described in "John Richard's Manual of Machine Construction," and I recommend them to any draftsman desirous of doing away with the annoyance of a set of fancy curves, to say nothing of the expense of such. Three sizes are enough for the drafting room, viz., ¾ inch by 3 inches, 1½ inch by 6 inches and 3 by 12 inches. Both ends are true parabolic curves, easily obtained once for all three patterns. An old wood or rubber straightedge is the only material required to build them, and if you have no access to a pattern shop you can make them yourself by first roughing out with a sharp knife and finishing with a smooth file and sandpaper. Besides, as advocated by the same author, larger sizes with same proportions can be made for the use of the patternmaker, who is thus enabled to reproduce exactly the outlines wanted by the designer.

A cheap and handy bottle-holder is one of sheet zinc or brass sheathing, either for round or square India ink bottles, and is as safe and much lighter than those of heavy wood pattern. (See Figs. 6 and 7.) If for a round bottle, a vertical ring ¾ inch wide slightly tapered toward the top and sheared off about the edge in four or six places, is soldered to a square base as per sketches, the lower part being the maximum diameter of the bottle. The holder is then slipped over and driven down. The taper and notches make it adhere firmly.

In the case of a square bottle-holder it is still simpler, as soldering is not resorted to. Take, as before, a square sheet of zinc, and after having drawn in the center a square corresponding to the dimension of the bottle, cut in diagonal slits as shown in heavy lines on sketch, turn the angles upward for about 45 degrees and slip the holder over the bottle. It will readily adjust itself and grip tightly enough to prevent the bottle from going off. The distance marked *A* should be ¾ inch or ⅞ inch; this is quite sufficient to obtain good steadiness. A small rest *R* for the drawing or writing pen, made of a bit of zinc soldered on each side, adds a little improvement. When the bottle is empty don't throw it away, but fill it up with the contents of the new one. They are not all of exactly the same dimension and zinc not being as springy as steel would soon lose its grip after a few changes. I insist upon the base being square and not round, for steadiness. Knock off the sharp corners for the sake of appearance and convenience, and once tried you will have no other.

Haiphong, Tonkin, China. EDW. C. CHODZKO.

HOW AN APPRENTICE DID A JOB—ADVICE TO APPRENTICES.

Editor MACHINERY:

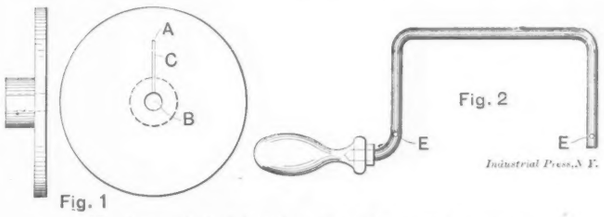
A short time ago we had a cast iron plate, shown in Fig. 1, in which it was required to cut a slot from *A* right into the hole *B*.

The foreman was busy, so he gave the job to one of the apprentices, saying, "Here, Jim, make a slot in this about so long." He walked away without any further instructions and Jim looked after him wondering how he was going to do the job, as the largest hack saw in the place would only go to a depth of about 3½ inches and the plate was 14 inches in diameter. He thought for a few minutes, then got a piece of 5-16-inch cold rolled stock and bent it, at the forge, to the shape shown in Fig. 2. He had the frame long enough for a 12-inch hack saw blade and with dip large enough to reach the center of the plate, two holes were drilled and tapped at *E E* to hold the blade.

He then drilled a couple of small holes in the plate from *A* to *C*, enough to allow the blade to pass through, then, placing the frame over the plate, he inserted the saw blade through the holes and, joining it to the frame at *E E*, he successfully sawed through to the center. This may not seem a great trick in the eyes of an experienced machinist, but I thought it pretty clever for a young lad to work out alone.

I have a habit of looking in the machine shops that I come across whenever I find a window open. A while ago I happened to glance into one where I found a pane of glass out of the window. Four young lads were working at a bench nearby and did not notice me. Soon I heard one, who was scraping a babbitted box in a half-hearted way remark, "You fellows will never learn anything in this place, they'll never give you a show."

I find that is the idea of many of the lads I meet nowadays. They imagine they ought to get better work every time. If tedious or dirty jobs come along they feel as if they were



The Apprentice's Job and the Saw Frame made to do it.

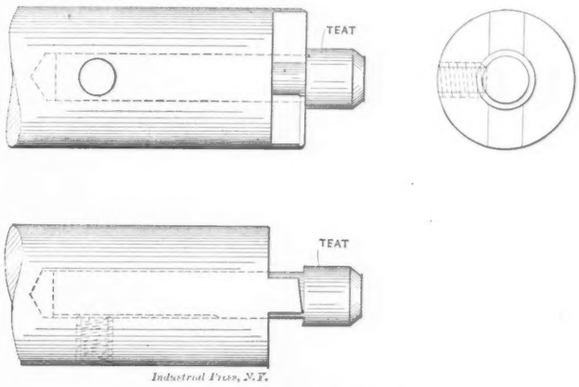
the only ones who get them. My sympathy goes to the young man who takes everything as it comes along and does not put on a face that would give one the blues just as soon as he gets a dirty job. Many boys nowadays start in the machinist's business with the idea that they come as apprentices; but they will find, in a short time, that they are there to work and if they can pick up anything worth learning, well and good, if not, it makes no difference to the employers so long as the work is done. But if they are bright, accommodating and not too "fresh" they will not lose much by this system of things, as most of the men are willing to help them all they can.

S. Boston, Mass. PATRICK J. KING.

SWEEP OR COUNTERBORE WITH REMOVABLE TEAT.

Editor MACHINERY:

I herewith show a form of sweep of which several are in use at our shop and giving satisfaction. It costs no more to make this than the solid form, and is much longer lived. The teat being removable makes it easy to grind, and when desired different diameters of teat may be used in the same tool.



Counterbore with Removable Teat.

We use these sweeps much as twist drills, wearing them back almost to the setscrew, and find them efficient for sweeping or shallow counterboring in cast iron where the scale is to be removed also. Having but two teeth is not a disadvantage; it breaks through the scale with less pressure than if there were four, and is more easily made and ground.

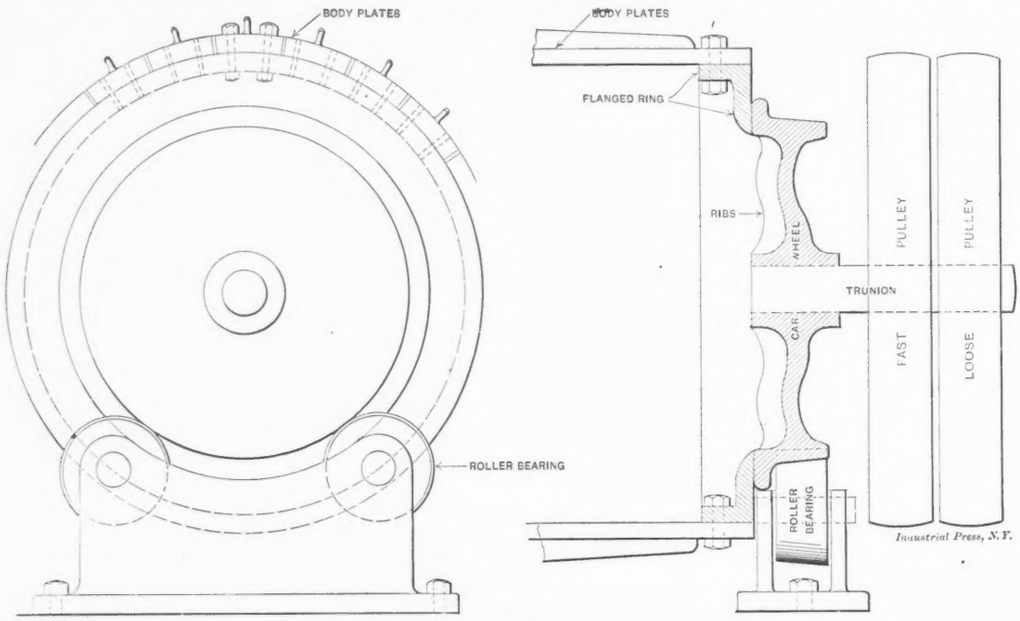
Those who spend part of the time in mechanical scheming should try the following: When rough sketching something new, use tissue paper to lay over the sketch, and pencil alterations and improvements on that before embodying them in the sketch. It will save much time and give the eraser of your lead pencil a chance to last as long as the lead. I found the tough tissue paper used for copying letters to be very good. CORNEIL RIDDERHOF.

Grand Rapids, Mich.

RUMBLING MILL.

Editor MACHINERY:

The sketch herewith shows an oddly constructed rumbling mill. The ends are cast from a car wheel pattern to which a flange ring is built on. The wheel and ring are one casting. Holes are bored in the ring to receive the body plate bolts. The roller bearings are cast steel supported by the brackets shown. Tight and loose pulleys are mounted on the trunnion shaft for driving. The pattern work is a simple matter. The regular car wheel is not changed in any way, a plain flanged ring being built on the wheel, which can be removed at any time. The boring for the trunnion shaft was done on the regular car wheel boring mill.



Rumbling Mill Heads adapted from Car-wheel Pattern.

Chicago. FOREMAN.

MUST SELECT GOOD APPRENTICES TO MAKE GOOD MECHANICS.

Editor MACHINERY:

Permit me to say a few words in answer to the question, Why are not the young men in the shops more ambitious and progressive? which seems to pervade O. P.'s article in June number of MACHINERY.

In order to be ambitious and progressive one must have an active mind, and as education trains the mind to act one's education becomes a good measure of one's ability to progress.

The average apprentice has but scant education, and therefore should not be expected to be very ambitious or progressive. The advantages of an education are so apparent and generally recognized that few young men of good mettle fail to secure one. It is true that some boys are so ambitious to earn money that they leave school at an early date to go to work; but they usually make the same short-sighted mistake in not mastering a trade that they did in not staying in school. It is also true that some boys of good make-up are forced by necessity to leave school, and because of the low pay of apprentices they do not learn the machinist's trade. Of those who have gone through the common school, but who cannot, or do not care to, go farther and reach a profession, the stores and offices (largely because of clean surroundings) secure the best.

On the side of the employers there seems to be little effort made to get "the best." The wages offered are too low to attract a young man who feels that he possesses the ability to accomplish something in the world. The employer also usually overlooks the matter of education and looks more to the muscle. The matter of habits is also overlooked. A boy of sixteen who has been using tobacco so long that he cannot quit and that it has taken the keenness from his intellect readily secures an apprenticeship.

While the machinist's work offers an opportunity for the exercise of as great talent as any other vocation, and while, in the end, reward is as certain, it is thus seen that the bright, ambitious young men seldom seek the shops and the shops seldom seek them. The whole matter reminds me of a little story which runs thus: A man passing a boy at work in a cornfield stopped and said: "Say, Bub! that corn looks rather yellow." "Yes," the boy replied, "we planted the yellow kind." "But it is pretty small," said the man. "Yes," answered the boy, "it is the small kind." "I don't believe you will get more than half a crop," the man continued. "We don't expect to; we planted it on halves," was the boy's answer. And my answer to O. P.'s article is that the crop of young men in the shop is just according to the planting.

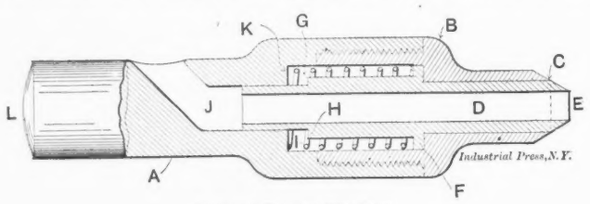
Grand Rapids, Mich. G. E. MILES.

A TOOL FOR CUTTING WASHERS.

Editor MACHINERY:

In the accompanying drawing is illustrated a very convenient implement for cutting washers from leather, sheet rubber and various other soft materials.

It has a handle portion *A* with a threaded hole, into which is screwed the externally threaded lower section *B*, which is of tool steel and has a hardened cutting edge *C* of the same diameter as the outside of the required washer. This member *B* is bored to fit the lower part of a tubular piece *D* of tool steel, which has also a hardened cutting edge *E*, the same diameter as the hole in the washer. The tubular member *D* extends upward through the spring chamber *G* in the parts *A* and *B*, and has a bearing in the hole *J*. A collar *F* is formed on the tube *D* to fit the spring chamber *G*, and bearing on this collar *F* and the internal shoulder *K* is a spiral spring *I* which normally keeps the tube *D* in the position shown in the drawing. Where the tube *D* enters the hole *J* it is reduced in diameter, and a shoulder *H* is formed, which acts as a stop when the tool is in use.



Tool for Cutting Washers.

The operation of the tool is to place it on the material to be cut with force sufficient to compress the spring *I* until the shoulder *K* comes in contact with shoulder *H* of the tube *D*. The cutting edges *C* and *E* will then be exactly in line, and

the washer is cut by striking a blow on the upper end. The cuttings from the holes in the washers as they accumulate in the tube *D* pass up and out of the hole *J* in the side of the handle.

The advantage of this construction over a solid punch consists in the fact that the washers are thrown off the punch as soon as they are cut, and the work is, therefore, more rapidly done and of a better quality.

The thread on the part *B* is made external, because cheaper and easier to make in case of a renewal.

Brooklyn, N. Y. C. D. KING.

TURNING SPLIT PISTON RINGS.

Editor MACHINERY:

In the March issue of MACHINERY I noticed an article on turning piston rings after they are split. Without comment I send you the following method, which I have used for several years:

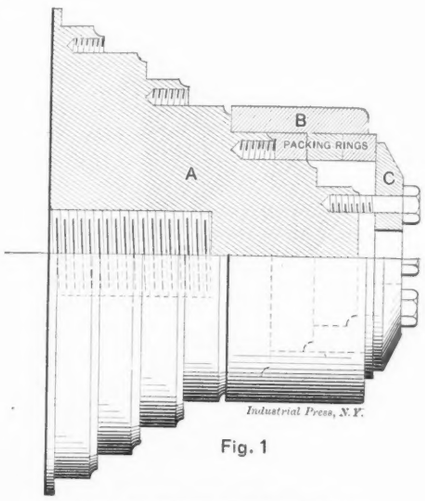
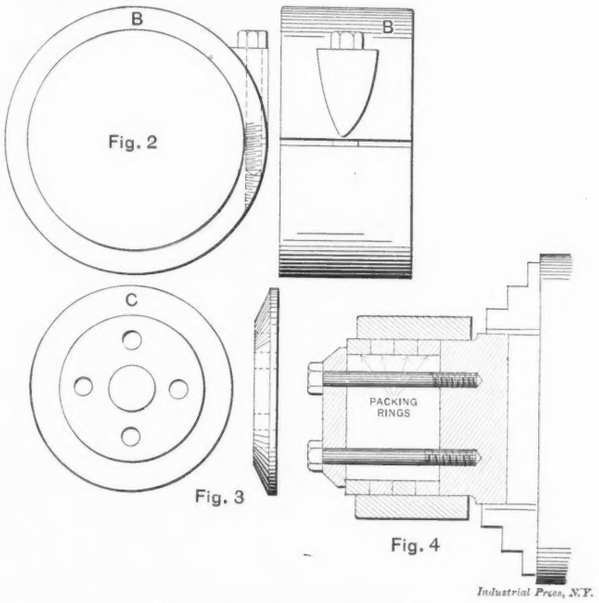


Fig. 1

Chuck for Holding Split Piston Rings.

It consists of one main casting *A*, Fig. 1, containing steps for the rings of the various sizes of engines. One split ring *B*, Fig. 2, and a plate *C*, Fig. 3, are provided for each size of ring to be turned. The split ring is clamped on its respective step of the cone, the rings for one engine are placed in it



Clamping Ring, Holding Plate, etc.

and the plate bolted on, thus securing the rings firmly to the cone. The split ring is then removed and the rings are ready to be turned. The split rings are bored 1-16 inch per foot larger than finished diameter. This allows enough stock for finish-turning the rings which are of the eccentric type. The small clearance offset on each step of the cone is to obviate the nuisance of having different lathe hands determine for the shop how far to run the cut out.

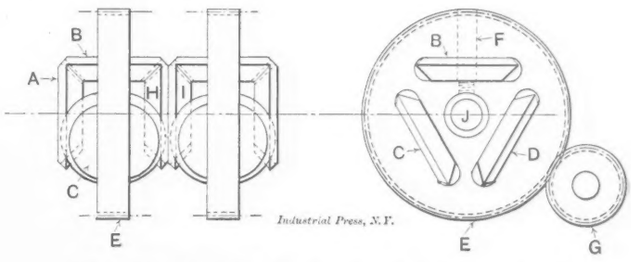
As will be seen, there is a series of tapped holes for the bolts that hold the clamping plate. This is so that the number of holding bolts may be increased as the size of the ring increases. When only one size of ring is to be turned, as for a repair order in a jobbing shop, a common plate secured in a lathe chuck and a solid ring, as shown in Fig. 4, would do a first-class job, and, I venture to say, would do it a great deal cheaper than it could be done by "A Subscriber's" method. A. C. MUFF.

Los Angeles, Cal.

A GEARING KINK.

Editor MACHINERY:

In Figs. 1 and 2 is shown a speed changing device, which is used for doubling or halving the speed of a shaft, and consists of the bevel gear *A*, which is the driver, three bevels *B*, *C* and *D* mounted in the body of the spur gear *E* on studs *F*, the gear *E* meshing with one or more pinions *G* that modify the motion of the device. Meshing with the bevels *B*, *C* and *D* is another bevel gear *H* which communicates motion to any desired mechanism, or may be connected as shown to a second driving bevel gear *I* and a duplication of the parts *B*, *C*, *D*, *E*, *F* and *G* to introduce a second modification of speed.



Case where the Number of Gear Teeth must be Divisible by Three.

As originally planned, all the bevel gears *A*, *B*, *C*, *D* and *H* were made miters, with each 32 teeth, 32 pitch. After the gears were cut, and an attempt was made to assemble the device it became very evident that the miters *A*, *B*, *C*, *D* and *H* would not mesh when set up on the shaft *J*. Miters *A*, *B*, *C* and *D* would, of course, run together, but the fact that *A* and *H* had each 32 teeth brought about a disagreement.

It was found necessary to have the numbers of teeth of the gears *A* and *H* divisible by three, and new ones were therefore made each having 33 teeth. With slight changes in the distances of gears *B*, *C* and *D* from the center of the shaft, and other slight changes in the angles of the teeth of all the bevel gears, they all meshed when set up on the device.

Brooklyn, N. Y. C. D. KING.

FRICTION IN THE SHOP.

Editor MACHINERY:

Some years ago it came in my way to assist in certain tests looking to the determining how much of the energy generated in certain shops was lost in friction, and how much resulted in useful work. Within a year of that time I was an inspector on work that required my presence throughout the day at a large structural works plant. This plant covered acres of ground and consisted of many departments. My duties were not arduous at all, in either of the above cases, and left me much time for looking about; and this being a congenial occupation for me, I used my time up pretty well. One of the discoveries I made in both the above cases was that while there were large wastes of energy in the shafting and belts due to friction, there was another loss from friction that is not to be neglected, by any means, if the best results are sought. This was the friction between the several departments and between the men in the departments. My duty as an inspector consisted in seeing that the work was done as the contract called for, and also to explain any blind places in the drawings. The firm being an honorable one, the first part of my work was very small; consisting in correcting mistakes or preventing their occurrence. In reality my

largest duty, I found, was to act as a lubricator and to supply a drop of oil at regular intervals, where the departments rubbed together. Without this lubrication the friction would at times cause actual abrading. If this became so marked that it was likely to cause investigation by the manager, the departments dropped a little oil upon the wearing surfaces themselves.

As the contract I was employed upon was only one of many going along at the same time, it gave me a chance to weigh matters, and I came to these conclusions: First, that all the angular dispositions are not in the farming communities. Second, that the heads of most departments had rather more than they could attend to and that they should have time to cool off occasionally. In my own case when I found my

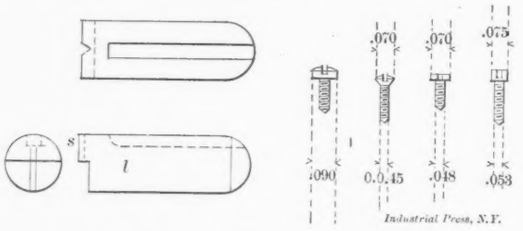


Fig. 1.

temper getting the upper side, a little stroll about the yard made all things well, and being my own "boss," it was possible to make such a trip without having to fret myself as to whether the manager saw me away from business or not. One of the department superintendents seemed also to have found out that a stroll was a good thing, and when things went too hard to stand much longer without an explosion, he would make a trip to that part of the yard where the raw stock was unloaded from the cars, and "unload his car" by "blessing" the Carnegie Company for sending just that stock he was least in need of. A trip of this kind caused him to be the "best natured man in the bunch."

Now, in some of the departments there was a large internal friction, or friction between man and man of the working force. This was much or little, depending upon whether the men were well lubricated by the department head or not. There was one department upon which all the other departments were willing to combine to put a perpendicular pressure —the pressure that generates friction—and that was the drawing room and its force. Now, if equilibrium is maintained, a pressure must have a corresponding resistance. In this case the drawing room maintained its position, so I judge there was the usual resistance.

In all rotating bearings we not only try to reduce the friction to as low a factor as possible, but we try to keep it at as short a radius as we can. This reduces the work of friction, which is to be desired. In the case of the works mentioned, the friction between the department of drawing and the other departments was exerted upon a long lever, or radius, and that between the other departments at a somewhat shorter radius, and the friction between workman and workman at a yet shorter radius. In the first case there was but one bearing, even if the radius was long; in the second case several rubbing surfaces were in contact even if at a shorter radius; and in the friction of man and man, many surfaces may have been in contact. All have heard much of reducing cost by having a speed boss and a feed boss. Wouldn't it be well to have a lubricating boss? Not a boy more or less swelled by his importance, but a man who knows human nature, has had to learn what it is to control himself, and has diplomatic manners.

In connection with the subject of friction and the work of friction, I would suggest that X and Y, in W's article in the July issue, look up the different leverages brought into action by the enlarged center hole; and I would also like to ask R. B. Casey why he corrugated the shoulder of his jig shown on page 356, Fig. 4, and did not corrugate the disks.

BEAUCHAMP.

SMALL SCREW SLOTTER.

Editor MACHINERY:

This device was designed to slot small screws such as used by jewellers, opticians, etc. An automatic screw machine was recently installed in the plant where I am employed, for the manufacture of small screws like those shown in Fig. 1 in enlarged form. In the beginning a temporary slotting machine was rigged up, having a hand lever in the end of which the screws were inserted one by one and pushed up against the slotting cutter. This method, however, is slow and deficient in many ways, and a slotting machine was designed.

This machine is of the rotary type and its main features will be evident from Fig. 4. A disc, *C*, has a series of 16 jaws ranged in a circle near its periphery for holding the screws to be slotted. The disc is rotated slowly by a worm and wormwheel, indicated at *E* and *D*, driven by the shaft *O* on the end of which is a pulley for a small round belt. As each pair of jaws passes slitting saw *X* successively, they are pressed together by crowding between the points of the set screws, *M*, and thus clamp the screw during the slotting process. After the screws have passed the saw they remain in their seats between the jaws until they reach a sheet steel knife, *W*, which passes between the jaws and opens them sufficiently to let the screws drop out into a box underneath the disc.

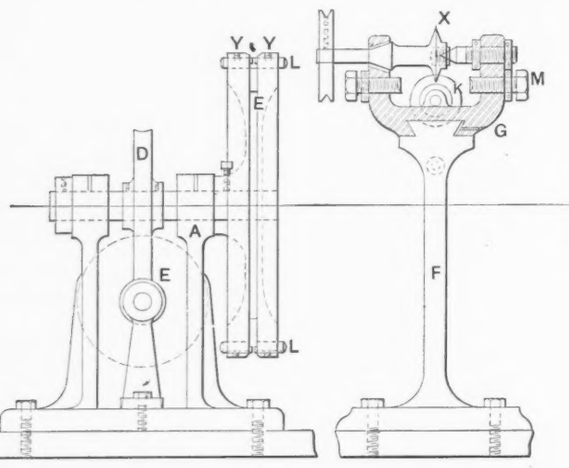


Fig. 2.

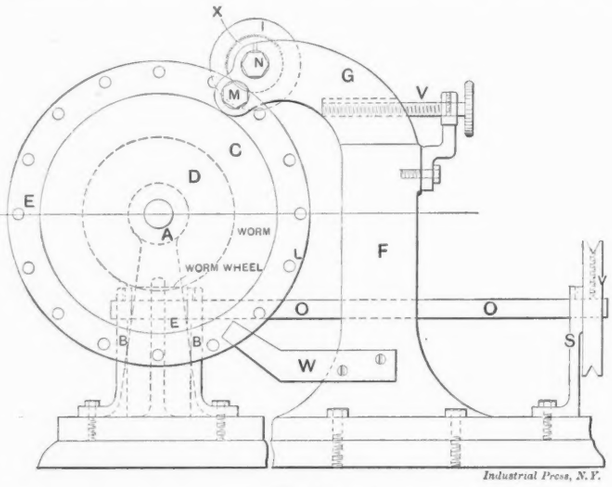


Fig. 3.

Fig. 4.

The details of the rotating disc which carries the screws are shown in Fig. 4, and in Fig. 3 is a sectional view of the saw and its standard or support. The studs or jaws *L*, in the disc, Fig. 2, are shown in detail in the enlarged view, Fig. 1. They are free to slide endwise, but are kept from dropping out of the disc by set screws. A V-shaped groove milled across the ends of the studs serves to hold all the screws turned out by the automatic screw machine ranging from .040 to .065 inch in diameter, regardless of the shape of the head, and only one set of jaws is required. In setting

the machine for screws of different sizes it is only necessary to adjust the bolts, *M*, Fig. 3, so that when the jaws pass between the ends of these bolts they will press lightly against the screw threads. I prefer the plain grooved jaws to threaded jaws, which are sometimes used, because with threaded jaws the boys who operate the machine sometimes fail to set the screws in proper position and the heads will be slotted too deep. The jaws should be hardened, as experience shows that jaws of soft steel soon become worn and the screws are sometimes slotted out of center. The jaws do not press against the screw threads hard enough to mar them and there has been no trouble from this source.

The construction of the saw arbor will be plain from the sectional view, Fig. 3. The upper part of the support for the arbor is movable and dovetailed to the base *F* and can be moved, to adjust the depth of cut, by the thumb screw, Fig. 4. The saw is driven by a round belt and should run about 600 revolutions a minute. The disc or faceplate makes two turns a minute and the machine thus has a capacity of 32 screws a minute.

It is hardly necessary to state that great care should be taken in machining the disc. The holes for the jaws *L* should be spaced and drilled in the milling machine; then a reamer, several thousandths smaller than the desired hole, should be centered true and the holes reamed in the milling machine as well. A rose reamer, made from a piece of the drill rod used for the jaws completed the job of reaming and the resulting holes were so accurate that no fitting was necessary. After the jaws were all in place they were pushed together, as if in operation, and tightened by the screws *Y*, *Y*. The disc was then put on its shaft and a light cut taken with a pointed tool, to form the shoulder *S* in Fig. 1. This was done to obtain a perfectly uniform distance from the center of the shaft to the tops of the jaws, which serve as seats for the screw heads and gage the depth of slot which is cut in the screw head.

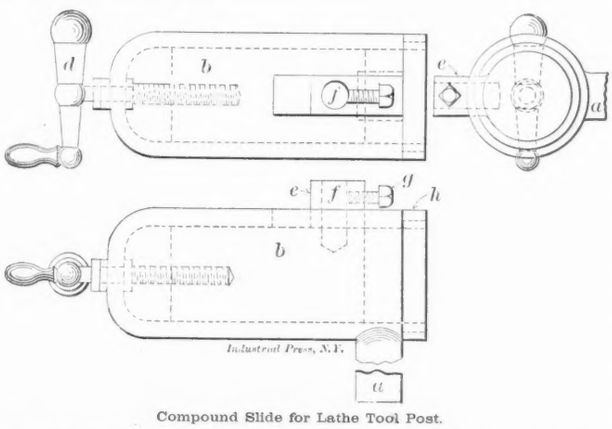
FRANK GREIMER.

COMPOUND SLIDE FOR LATHE TOOL POST.

Editor MACHINERY:

The accompanying sketch illustrates a very handy device, for use in the tool post of a lathe, for turning short bevels.

The body of the device is held in the tool post by the lug *a*, and when it is desired to turn bevels on the opposite side the device is withdrawn, turned upside down, and again inserted in the tool post.



Compound Slide for Lathe Tool Post.

Inside of the main casting slides the block *b*, which is a good running fit, and is fed in and out by the screw and handle *d*. On one side of this block is a lug *e* which projects out through a slot in one side of the main casting. In the end of the lug is a hole *f*, in which the tool is placed when it is held in position by the set screw *g*. The collar *h* is screwed or shrunk on the end to prevent the slot from opening.

Waterbury, Conn. W. W. COWLES.

PICKING UP THREADS.

Editor MACHINERY:

One of the best time savers when cutting a thread on an engine lathe, is the ability of the operator to open the lead screw nut, run the lathe carriage back by hand and pick up the thread again. There have been many ways devised for doing this, some of them being quite elaborate and using mechanical attachments. Very few of these are found in the average shop, however, and what the ordinary man wants is a way to do the trick without an expensive attachment, and by a method easily learned and used. When the writer was an apprentice he recalls seeing one of the workmen place a rule on the ways of the lathe, stop the machine, measure back one inch and start up again, and he had the thread. This was a rather slow method, but it demonstrates the principle of all "drop threading."

Let us suppose, in what follows, that our lead screw has six threads per inch.

If we were cutting 11 threads per inch it is evident that the spindle would have to make 11 turns while the lead screw made six turns and the carriage had moved through a distance of one inch; and at this point the thread on the screw and on the work would be in the same relative position as at the start. When there are no fractional threads to be cut, therefore, we may pick up the thread at the inch positions, when the lead screw has completed six turns or a multiple of six and the carriage has moved an even inch or a number of inches.

When the machine is running, however, it is not convenient to gage these inch positions by measurement, neither is it convenient to have to watch more than one point on the lathe. An easier method is to count the number of turns made by the lead screw and to depend upon that for a guide, since the screw always runs at so slow a speed as to be easily counted. The method described below depends upon this principle and is so easily learned that it can be used with success by those who have just started to learn the trade.

In order to readily count the number of turns made by the lead screw, cut out a piece of triangular-shaped tin to serve as a pointer or indicator. The piece of tin is to be clamped under the nut at the end of the lead screw and should be long enough so that it can be seen projecting above the edge of the gear.

Now let us suppose that we are to cut a thread one inch long on a piece, 14 threads per inch. Make a file mark one inch from the end of the work to indicate the length to be threaded. Run the tool over the work, taking a very light cut, and stop the lathe at the file mark. While the lathe is stopped throw out the lead screw nut and run the carriage back by hand; but instead of stopping after the carriage has run back an even inch, we will move it 1½ inches in order to give the operator a chance to get the chasing tool into a cutting position before the end of the thread is reached. In this case we may stop at an even half-inch instead of at an even inch, two inches, three inches, etc., because only half-inch divisions are required to give even threads. Thus, in one half-inch, the lathe cuts seven threads, as now adjusted, while the lead screw makes three turns and the threads of the lead screw and on the work come into the same relative position every half-inch. If we were cutting 11½ threads per inch instead of 14, as at present, we should have to wait until the lead screw had made 12 turns and the carriage had moved through two inches, because we cannot get an even number of threads in less than two inches of our work.

Having moved the carriage back 1½ inches, as above stated, push the foot stock firmly against the carriage and clamp it in place to serve as a stop to run the carriage against each time we move the carriage back. Now adjust the piece of tin to be used as an indicator so that it will be just past the line of sight behind the lead screw bracket as we stand at the carriage.

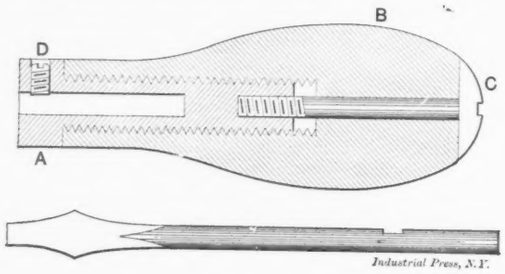
We may now take a cut over the work, open the lead screw nut, run the carriage back against the foot stock, and when the lead screw has completed three turns, as shown by the pointer (the three turns corresponding to the half-inch travel) throw in the nut and the tool will follow in the thread. When taking a cut on the thread, watch the work closely and when the tool reaches the file mark draw it back. At the same time open the lead screw nut, glance at the indicator as soon as the nut is opened, and, watching it, run the carriage back against the foot stock. When the lead screw has made three turns, throw in the nut and take the cut as usual.

J. A. P.

CONTRIBUTED NOTES AND SHOP KINKS.

COMBINATION TOOL HANDLE.

C. W. Shelly has sent a sketch of a combination handle which is convenient and saves a great deal of space in the tool box. A ½-inch filister-head cap screw *A* is screwed into a vulcanite handle *B*, in which it is held in place and kept from turning by the special ¼-inch round head screw *C*. The

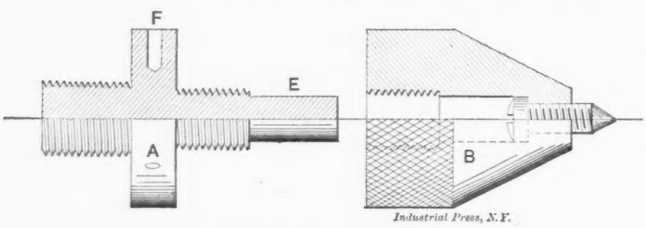


Section of Handle.

cap screw has a ¼-inch reamed hole about 1½ inches deep, the end of which serves for a tool socket, while a No. 10-32 casehardened, headless setscrew *D* holds the tools in place. This handle can be used for screw drivers, hand turning tools, scrapers, etc.

SIMPLE CHUCK FOR FINISHING SCREW POINTS, ETC.

"R. F." has sent a sketch of a special chuck which he has found handy for use in cutting off screw ends, for holding screws when polishing the points, or holding any pieces which are not conveniently handled in an ordinary chuck. It consists of the chuck *A* and cap *B*. One end of *A* is threaded to fit a hole tapped in the end of the lathe spindle, while the other fits the cap *B* and is provided with a straight shank *E*.

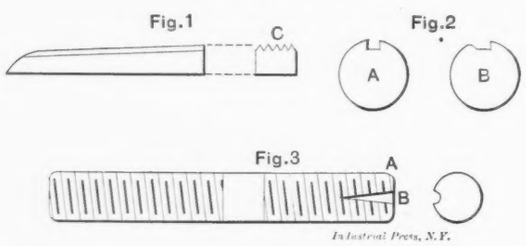


Chuck for Holding Screws.

The cap *B* is bored large enough for the body of the screw to pass out through the end and is counterbored for the head of the screw. To use this clutch, the screw is dropped into the cap, as shown, and the cap then screwed on to the chuck until the shank *E* forces the head of the screw firmly against the shoulder of the counterbore and thus holds it securely. Pin holes are drilled in the collar *E*, and the surface of the cap is knurled, to enable the chuck to be easily and securely screwed into place.

EMERGENCY KEY—KINK IN REPLACING STUDS.

H. M. J. writes: Fig. 1 illustrates an emergency key, especially adapted for mill work when a quick job is the object. I had a shaft as shown at *A*, Fig. 2, and the keyway became stripped as shown at *B*. It was impossible to get the shaft

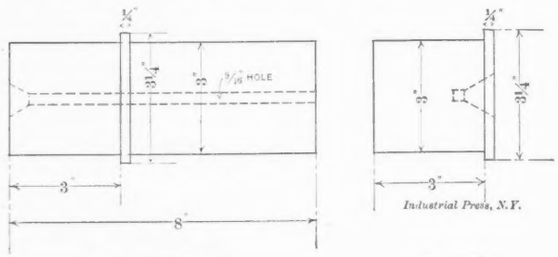


out without tearing out a lot of machinery, so I made a steel key, *C*, with 60-degree V-grooves cut lengthwise, as shown, and hardened on the small end. I turned the wheel around on the shaft until the keyway in the hub came opposite to the keyway in the shaft and drove the emergency key in the hub with the corrugations bearing against the blank shaft. The key is still in place and the only thing that troubles me is how I will be able to get it out.

Fig. 3 shows a stud to fit in a hole where the thread has been worn oversize or partly stripped. The stud is made about 1-16 to ⅛ inch over the size of the hole, is tapered on the end at *A* and has a groove cut at *B* and is hardened. The end will cut its way in and enlarge the hole, chasing the thread a little deeper. If the operator uses good judgment he will have no trouble.

STEEL MANDREL FOR LARGE WORK.

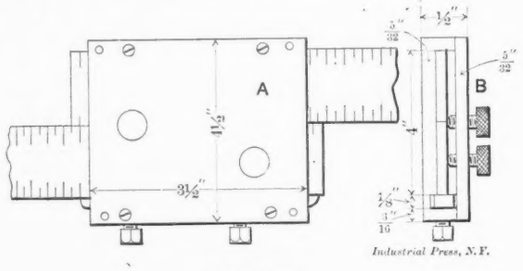
Robert A. Lachmann, Chicago, writes: I have had a great deal of trouble with soft steel mandrels, especially long ones, which had to be used in steel castings, some of which had holes 24 inches long. I decided to used hardened mandrels instead, in order to avoid the cutting that took place every time we had to drive an arbor in or out of a casting, and made inquiries regarding the cost of hardened steel mandrels, 3 inches in diameter and 27 inches long, such as were required for the work. As our grinder would not take a piece of work of that size it would have been necessary to have



ordered the arbors from outside and the price would have been not less than 20 dollars apiece. I finally decided to adopt the scheme outlined below and make the arbors myself, and it proved very successful. It consisted simply in making the arbors in two parts, part *A* being the longer and a good driving fit, and *B*, the shorter one, also a good fit. These were driven in each end of the hole of the casting respectively, and it is only necessary to add that to remove the short arbor *B* it was driven out with a short half-inch rod inserted through the 9-16-inch hole through *A*, thus giving a free chance to remove arbor *A* in the usual manner.

A SCALE-HOLDING DEVICE.

Barney writes: The sketch herewith is for holding two scales together to get a greater measurement than one scale will give. As we had no scale longer than 24 inches, but had two of these, I made the fixture shown, which answered the purpose of a long scale admirably.



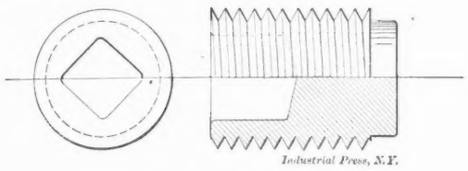
Scale Clamp.

This fixture can be applied to any two scales by changing the sizes to suit the scales at hand. *A* is the base of the fixture, which is made 4½ inches outside and 4⅛ inches inside diameter and 3-16 inches deep. It is beveled on one end to draw the face of the scale on that side down level. The other end is recessed to a depth of ¼ inch and has a gib to take the pressure of the setscrews. The setscrews are on the center of the scale and when tightened up they bring the scales together perfectly square. *B* is the top plate. It is fastened to *A* by four screws and dowels and has two thumbscrews to tighten down on the scales. The four fastening screws are recessed and have copper points inserted so as to

prevent damage to the scales. One of the two thumbscrews comes directly on the center and the other is placed in the center of the scale nearest the gib. The measuring is done on the edges that come together.

HEADLESS SETSCREW FOR DRILL PRESS SPINDLES.

M. H. Ball, Watervliet, N. Y., describes a setscrew for use in drill press spindles and drill sockets. Most people who have worked around drill presses equipped with the ordinary setscrew, have sometimes come in contact with its projecting head and have received a cut or bruise which was, to say the least, very unpleasant. This screw comes flush with the spindle when seated on the shank of the socket or clutch. It is made larger in diameter than the common setscrew to

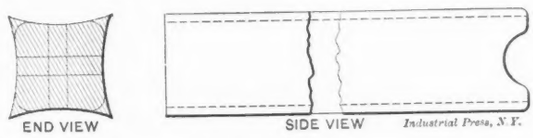


Headless Setscrew.

make room for the socket into which the wrench fits and leave enough metal around this hole to give it sufficient strength; and the corners of the socket are made with a small fillet for the same reason. The thread should be made finer than standard, from 12 to 16 threads per inch being about right. It requires a wrench similar to that used with several kinds of two-jaw chucks, which are too well known to need description, and it might be made to fit the same wrench when a clutch of this kind is used.

BORING TOOL FOR LATHE WORK.

Ezra F. Landis, La Salle, N. Y., describes a novel boring tool for lathe work, which in personal use has been found to work very satisfactorily, and which is in high favor with many machinists. The tool is made from square Mushet or any self-hardening steel, say ⅝ or ¾ inch square, and of suitable length. The sides are slightly concaved by grinding on an emery wheel so as to give sharp, clean cutting edges at all four corners. A cutter is ground on each corner as indicated



Boring Tools.

in the side view. By setting the tool in the tool-post a little above the center one edge does the cutting and the others clear. It cuts a smooth hole, the concaved sides giving a clean cutting or scraping edge. This tool is especially adapted for boring out small cored holes where stiffness and rigidity are prime requisites for rapid and accurate work, especially brass work. On small holes the tool is first centered in the hole and all four cutters cut out the stock; then it is used like an ordinary boring tool until the finishing cut, when it is used as above described.

USE OF BEVEL PROTRACTOR ON THE LATHE.

W. M., Auburn, N. Y., shows by a sketch, reproduced in the accompanying cut, how any angle may be easily made on a lathe by the use of a bevel protractor. If the lathe has no compound rest, an auxiliary slide *A* is bolted to the tool block and adjusted for the required angle, using the protractor as shown in the cut. This scheme, is, of course, well known to almost all machinists, but to many apprentices the use of a bevel protractor to get an angle in this manner is often a matter of some difficulty, as they do not thoroughly understand the use of this convenient tool. The Starrett is made so that when the blade is at right angles to the head the index line points to 90 degrees, and when the blade and head are parallel it points to 0 degrees. If such a protractor is to be used in the manner shown, at what angle should it be set to turn a 60-degree center? The line *xy* represents the center line or axis of the lathe. The side of the protractor blade must be inclined to this line one-half of 60 degrees, or 30 degrees. Now it is a principle demonstrated in geometry that the sum of the three angles of any triangle is always equal to 180 degrees. We know that the angle made by the faceplate with the center line *x y* is 90 degrees, because it is faced

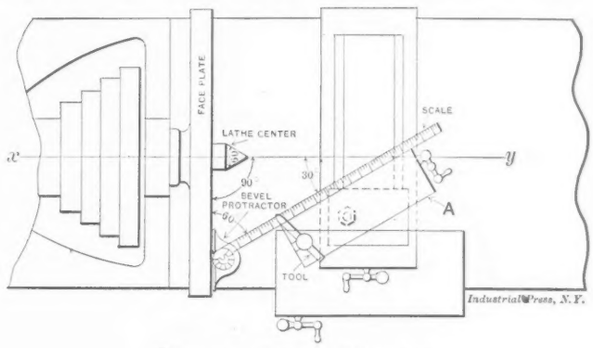
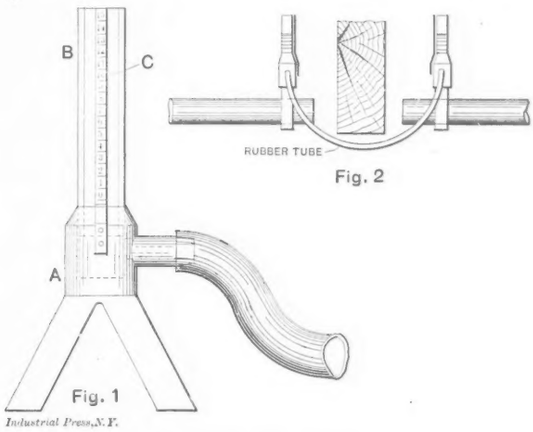


Diagram showing use of Protractor.

off "square." So, if we add together 90 degrees and 30 degrees and substract the sum, 120 degrees, from 180 degrees, the remainder, 60 degrees, will be the angle made by the protractor blade with the side of the faceplate, and that to which the protractor should be set to turn a 60-degree center.

HANDY LEVEL FOR UNHANDY PLACES.

W. C. Hensley, New Haven, Conn., has sent a sketch of a "handy level for unhandy places," which will be appreciated by those who have had occasion to "level up" surfaces which are separated by a beam or similar object. It consists of a pair of gages, one of which is shown in Fig. 1, which are connected by a flexible rubber tube. The body of the gage *A* is



of brass, the top being fitted with a glass tube *B*. A scale *C* placed on the side of the tube indicates the height of water in the gage. For use, one of the gages is placed on each surface to be leveled; they are connected by the tube and then filled with water. The same height of water in each gage indicates that the surfaces are level. Fig. 2 shows the device applied to leveling two shafts which are separated by a beam.

* * *

It is said that the English patents of the Bell telephone, which are of great financial value, were obtained through a slight accident which, however, was of enough importance to change the whole course of telephone development in England. When the telephone was being introduced in this country Lord Kelvin was here and was so much pleased with its operation that he took one to England to exhibit before his classes. When it was attempted to produce sound through it the instrument failed to work and it was later found that the trouble was due to the displacement of a small spring, which occurred during its transportation. Before Lord Kelvin succeeded in remedying this the English patents were obtained; but according to English law if he had discovered the disarrangement and rectified it so that the telephone would have been in use before the date of issue of the patents, Mr. Bell would have been compelled to forfeit his right to the patents.

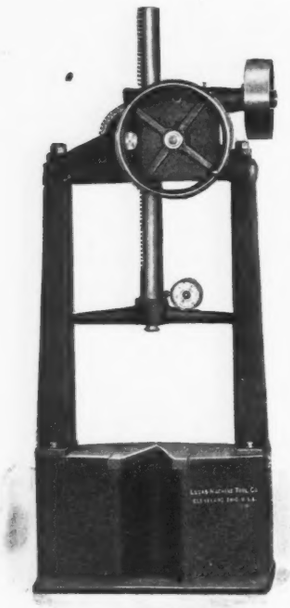
NEW TOOLS OF THE MONTH.

A RECORD OF NEW TOOLS AND APPLIANCES FOR MACHINE SHOP USE.

ARBOR PRESS.

An arbor press has been brought out by the Lucas Machine Tool Co., Cleveland, O. We are not able at the present time to give a description of the mechanism of the arbor press, but the following details of the results accomplished with it will be of general interest:

This press was designed to do such work as is done on a screw press, as forcing of mandrels and pressing gears and wheels onto their spindles in assembling, substituting belt power for hand power and at the same time making the operation more powerful, rapid and convenient. The pulley carries a belt which runs continually, driving a worm and worm gear. The handwheel on the front raises or lowers the ram quickly to the required position and when the ram meets with resistance a further movement of the handwheel operates a friction which engages the power and feeds the ram downward in proportion to the force exerted on the handwheel. As soon as the operator releases the pressure on the handwheel the motion of the press stops. He controls the action of the press entirely by the large handwheel which automatically gives the action desired. The mechanism is exceedingly simple and effective. The base of the arbor press is fitted with a sliding V plate set flush with the top, adapting it to the use of shafts from the smallest to the largest. The ram is fitted with plunger and hydraulic gage, graduated to read pressures up to 25 tons.



Arbor Press.

This press is made in several sizes, with and without gage.

PATTERNMAKERS' UNIVERSAL VISE.

The Emmert Mfg. Co., Waynesboro, Pa., have made an improvement in their patternmakers' vise, the cuts of which are shown in Figs. 1 and 2. This vise can be placed at 28 different fixed positions and operates on the same principle as the No. 1 vise which has been on the market for about one year and a half. It is one size smaller than that originally made, the dimensions of the jaws being 5x14 inches and opening to a distance of 12 inches.

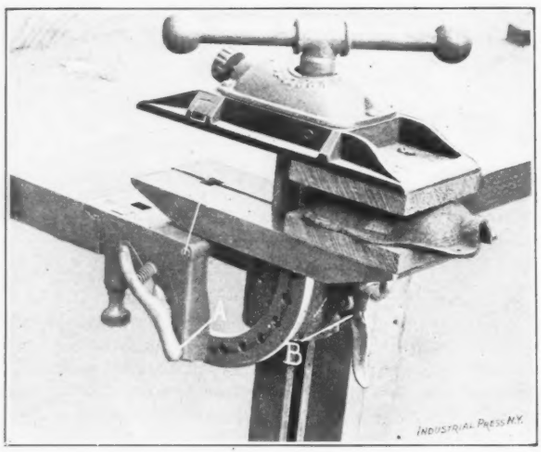


Fig. 1. Vise in Horizontal Position.

Referring to Fig. 1, the vise is designed to pivot about axis No. 1, so as to be brought either into a horizontal or vertical position, and also about an axis at right angles to this. This

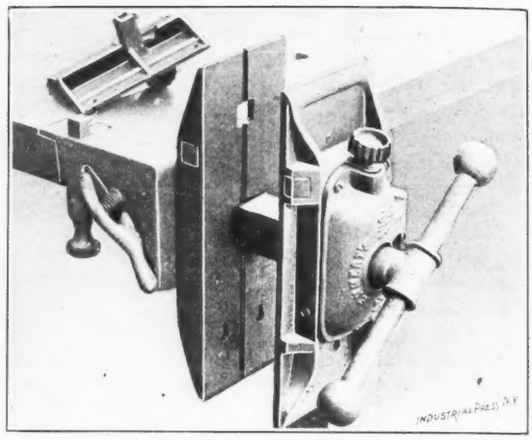
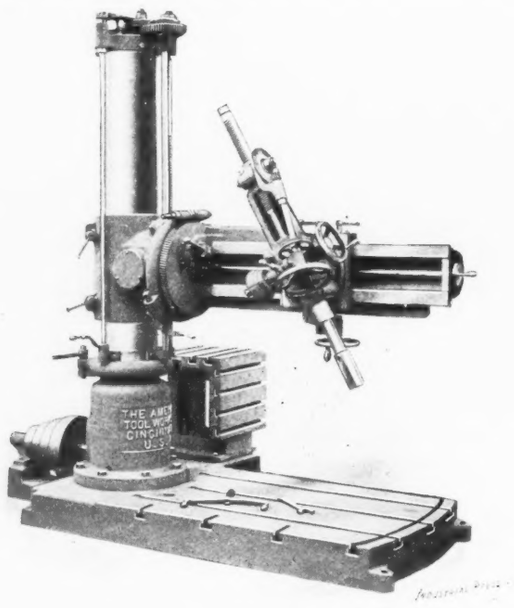


Fig. 2. Vise in Vertical Position.

makes it possible to place the vise at any angle between 90 degrees and zero, and have it point in any direction within these limits. The important improvement in this size over the original vise is the use of taper stop pins operated by the handles at *A* and *B*, for locating the vise in different positions, and holding it rigidly in place.

FIVE-FOOT FULL UNIVERSAL RADIAL DRILL.

In the accompanying engraving we illustrate a full universal radial drill brought out by the American Tool Works Co., Cincinnati, O. The design and construction of this machine are powerful. The column has been made unusually large and is firmly supported by an inside stationary stump extending its entire height with a bearing at the top, affording great stiffness and rigidity. The arm is of new and original design; it permits of all lower driving gears being brought direct to central driving shafts through the medium of bevel gears mounted on a vertical shaft and enclosed in the arm. It is raised and lowered rapidly by a double thread



American Tool Works Radial Drill.

coarse pitch screw running in a bronze nut directly on the load line, reducing friction to a minimum.

The head is universal in its action and is clamped in any position instantly by means of fixed binders at the top. Movement along the arm is controlled by a handwheel through a rack and multiple gearing. The spindle has three changes of feed, sixteen changes of speed (the back gears being located on the arm) and can be thrown in or out while the spindle is in motion by a convenient lever. Correct vertical position is determined by a dowel-pin in the head, thus insuring accuracy of alignment with the platen.

The tapping attachment shown is very useful where a great amount of tapping is to be done. By means of a patented friction located in the arm the tap can be advanced to its required depth, the lever thrown instantly and the spindle reversed and tap backed out at accelerated speed by throwing from gears-in to gears-out.

The motion of the spindle can be stopped instantly either by a lever controlling the back gear or by one controlling the friction, thus obviating all necessity of stopping the entire machine through the countershaft.

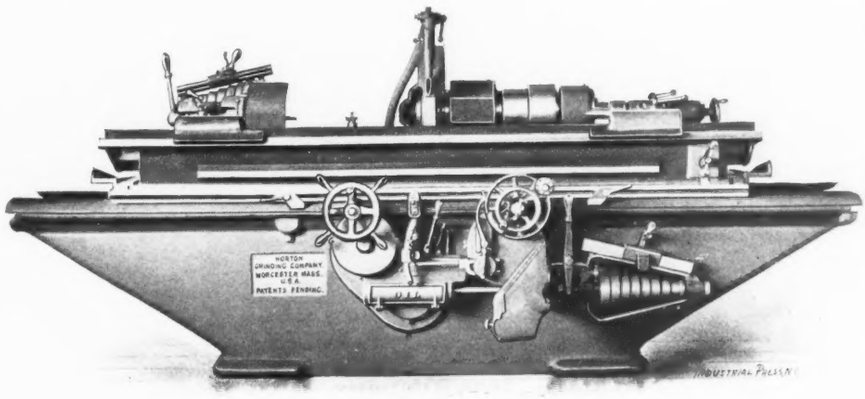
NORTON GRINDING MACHINE.

The Norton Grinding Co., Worcester, Mass., have brought out a grinding machine of smaller size than the 18x96-inch machine described in the June, 1901, number of MACHINERY. The new machine swings 12 inches and takes work 72 inches long between centers. It will swing 6 inches over the steady rest; will grind tapers up to two inches to the foot; and the net weight of the machine complete is 8,000 pounds.

This weight together with the facts that the wheel spindle and boxes are the same as in the larger machine and the capacity for removing stock is as great, indicates the power of this machine for heavy grinding. We received in a letter from the Norton Co. the following particulars:

"The design of this machine is practically the same as the 18x96, and it possesses all the features of the larger machine and the same capacity for removing stock.

"We have recently ground some lead screw blanks in our own shop and the result is very gratifying indeed. These pieces were ground direct from the merchant bar without any turning whatever. The length was 52 inches and the bar was 1 3-16 inch in the rough. They required only the same time in straightening, squaring off the ends and centering as would be necessary if they were to be turned. They were then ground direct from this bar to the finished size which

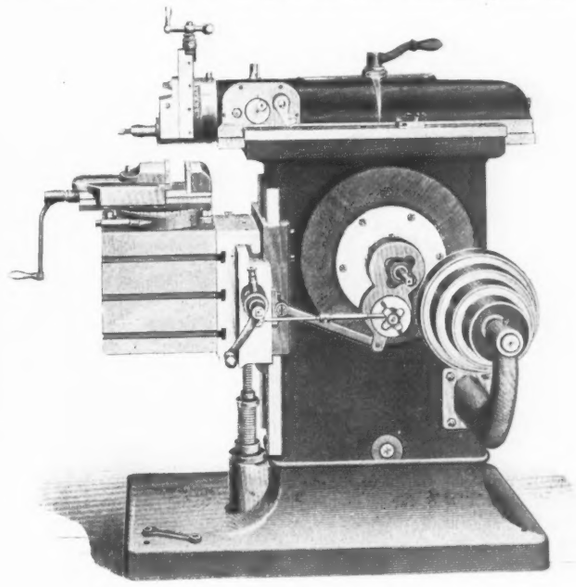


Twelve-inch Norton Grinder.

was 1⅛ inch, a reduction in diameter of 1-16 inch, in 35 minutes each. Plain shafts of machinery steel, 32 inches long, 1½ inch finished size, were ground from the rough bar in 30 minutes each, the reduction in diameter being 1-16. The same kind of shafts, only 62 inches long, was ground in 45 minutes each."

NEW STOCKBRIDGE SHAPER.

The Stockbridge Machine Co., Worcester, Mass., have brought out a shaper of new design which has several novel features that commend themselves to practical mechanics. It is fitted with an entirely new combination crank motion that has recently been patented and that we expect to illustrate in detail in a future number of the paper. The objects that it was sought to obtain in this crank motion were: An even cutting speed throughout the entire length of the stroke; a quick return of 4 to 1; and a very powerful cutting stroke in which the power is maintained throughout the entire length of the stroke. The crank is driven through a pinion and crank gear; but motion is also imparted to it entirely independent of the gear by a reciprocating block and pin, the effect of which is to give an even cutting speed to the



Shaper with Improved Crank Motion giving Uniform Cutting Stroke.

tool and to increase the driving force of the ram at points where it would naturally decrease, with the ordinary crank motion.

Other new features of the machine are a simple and automatic down feed for the head and a telescope screw for raising and lowering the table, making it very convenient to set the machine on a concrete floor or a masonry foundation where a hole for the elevating screw could not readily be cut. There is an opening in the frame under the ram through which shafts up to 2½ inches diameter can be passed when it is desired to spline them. The ram has a stroke of 16 inches; the head a vertical feed of 6 inches and the cross feed to the table is 22 inches. The vertical movement of the knee is 14 inches and the feet screws are fitted with graduated collars. The cross feed gears are covered and the rod connecting them with the ratchet pawl on the cross slide automatically adjusts itself to any position of the knee. The ram is of unusually large cross section. The vise is of the swiveled base pattern and is clamped in any position by the screw. The driving cone has four steps for a 2½-inch belt and is supported by two bearings. The shaper is of sufficient power to take a heavy cut from the beginning to the end of the stroke without the use of back gears.

UPSETTING AND FORGING MACHINE.

Engravings shown in connection with this give a general view and illustrate certain details of one of the most powerful mechanically-operated upsetting and forging machines ever constructed. This machine is built by the Acme Machinery Co., Cleveland, O., and is intended for locomotive builders, car builders and other users of heavy forgings where the constantly-increasing size of their product has

necessarily made all of the parts entering into its construction much larger.

The bed of this machine is a single steel casting weighing 18½ tons, which is as strong as a cast iron bed of four times the weight. The shaft which operates the gripping die and the plunger is of fluid compressed steel.

In Figs. 2 and 3 are details of the toggle mechanism through which motion is communicated to the die block. In Fig. 2, *A* is the frame of the machine and *C* the die block which grips the forging while it is being upset through the action of the plunger. The die block is operated through four links, *L*, and toggle block *B*, which is given a reciprocating motion. The use of four links compels the die block to close upon the work with a perfectly even and parallel motion, no matter whether or not the dies are at either extremity of the block. This is of great importance in forging close to size, because the die block is about 2 feet long and if moved with a single pair of links, would be very apt to close the dies unevenly.

The toggle block is operated by the toggle slide shown in Fig. 3, which receives its motion from a cam on the main shaft. This mechanism is designed to give the largest measure possible of what is known as "time," or among mechanics who are familiar with this machine, as "gather." In other words, the design is such that the dies remain closed as long as possible with reference to the advance of the upsetting plunger. After the dies close, the plunger still has a long distance to travel and the work can thus be upset to a greater extent for one stroke of the plunger than if there were a shorter "dwell" of the dies after they have gripped the work.

An important feature of the toggle slide mechanism is an automatic relief of new and novel construction, by means of a spring, so placed that it tends to bring the toggle levers into nearly a straight line. The left end of the slide, Fig. 3, which connects with the toggle block shown in Fig. 2, is free to move longitudinally within the main part of the slide, provided force enough should be applied to raise the toggle levers to the dotted position indicated in Fig. 3. This can occur only when some unusual pressure comes on the machine, which might cause a breakage of some of the parts unless relief were provided. The relief spring is adjusted to give about 10,000 pounds pressure and this pressure will give about 65 tons pressure at the gripping dies because of the multiplying effect of the toggle levers. This shows how a comparatively small spring can be made to exert a tremendous pressure. With a strain of over 65 tons comes on the machine the spring, of course, then yields and gives instant relief. The factor of safety throughout the machine is 15. The plunger pressure is 100 tons.

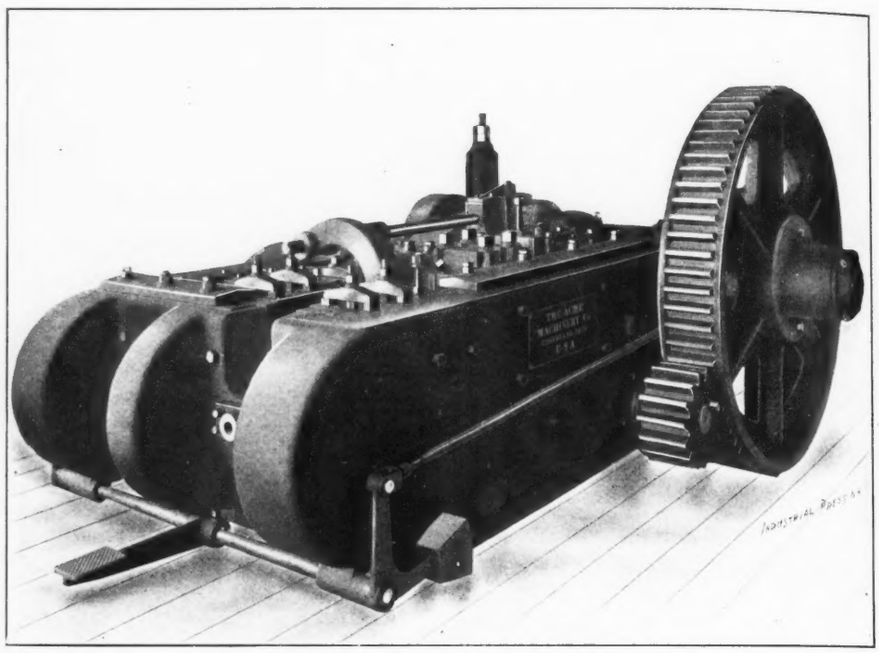


Fig. 1. Large Upsetting and Forging Machine.

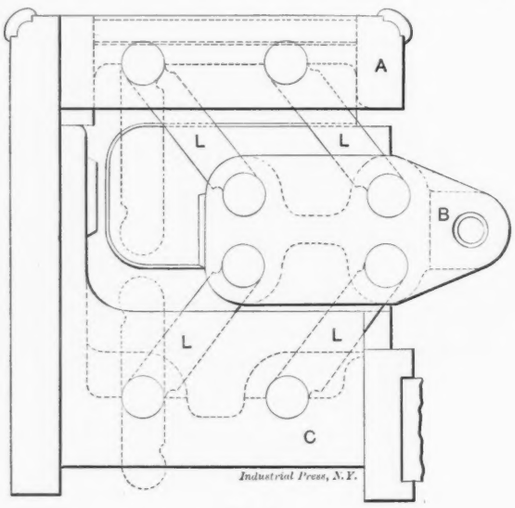


Fig. 2.

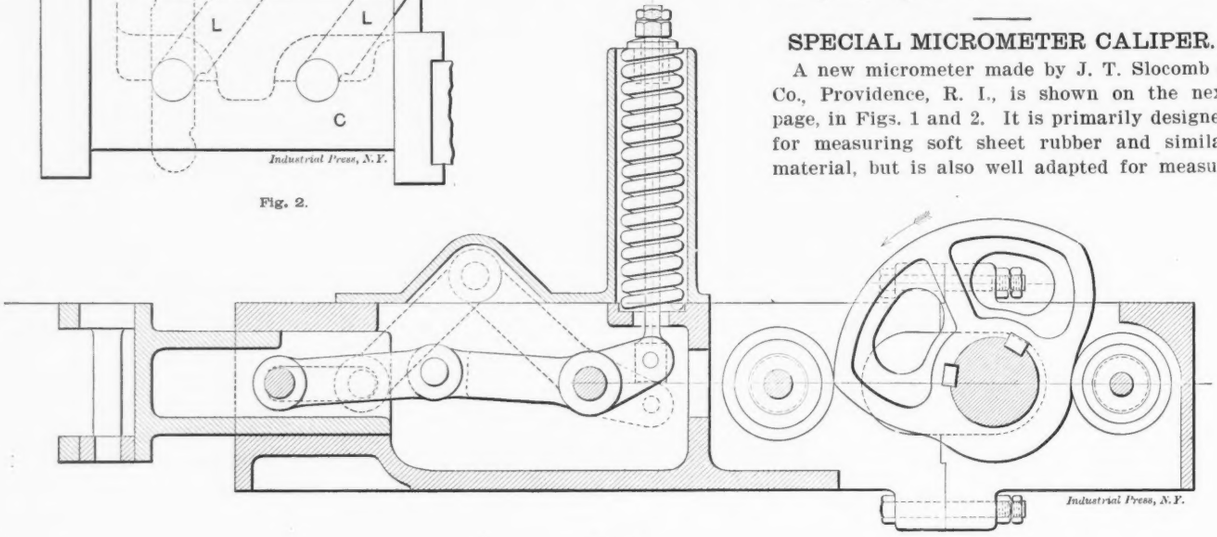


Fig. 3.

SPECIAL MICROMETER CALIPER.

A new micrometer made by J. T. Slocomb & Co., Providence, R. I., is shown on the next page, in Figs. 1 and 2. It is primarily designed for measuring soft sheet rubber and similar material, but is also well adapted for measuring sheet metal and wire. It differs from other micrometers in at least four points, viz.: 1. The thimble makes but one

revolution in measuring the full extent of its range (¼ inch). Consequently there is only one scale of graduations necessary. which is all on a dial in plain sight. 2. The lead of the measuring screw is so great that there is not much chance for error in measurement on account of difference in pressure on soft materials. 3. The instrument is held entirely by one hand when making measurements which leaves the other hand free to hold the material being measured. 4. Neither of the measuring points revolves, which is an advantage when measuring soft or sticky material.

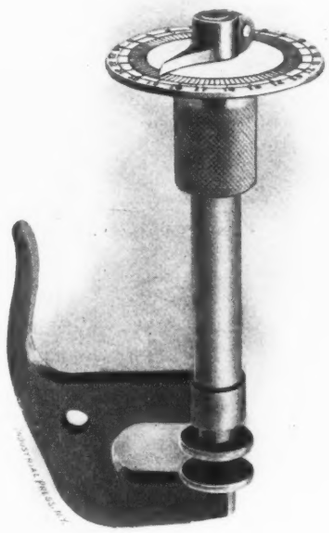


Fig. 1 Micrometer Caliper Gage for Measuring Sheet Rubber, etc.

The construction of the micrometer is made clear in the sectional cut Fig. 2. The thimble *D* has an internal screw thread, ¼ inch long, 32 pitch and ¼ inch lead. The enlarged end of the sleeve *E* has an external thread to fit the thimble, ½ inch long. This allows the range of travel to come on the external thread, which, of course, can be more accurately cut. The thimble also has a plain bore at *F* which fits loosely an enlarged part of the sleeve *E*. This construction is to exclude dirt from the screw. The plunger *G* has two bearings in the sleeve *E*, one in the enlarged thimble bore in the thimble end and one in the bushing near the measuring end. The plunger slides freely in a longitudinal direction in these bearings, but is prevented from turning by a small key working in a keyway in the sleeve *E*. The pointer *H* is clamped to the end of the plunger and does not revolve, the dial revolving beneath it as it is rigidly connected to the thimble *D*. Inside the sleeve *E* and around the plunger is the spiral spring *J* which is under compression and in torsion, thus taking up back lash in the screw threads. It also takes up

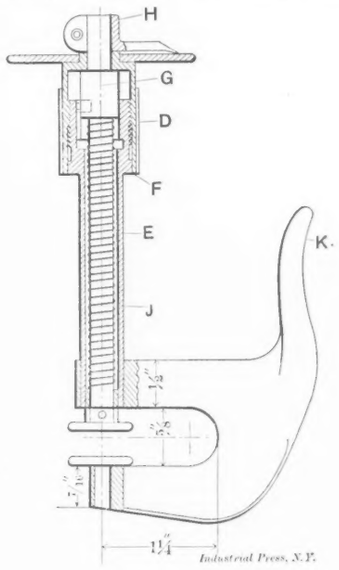
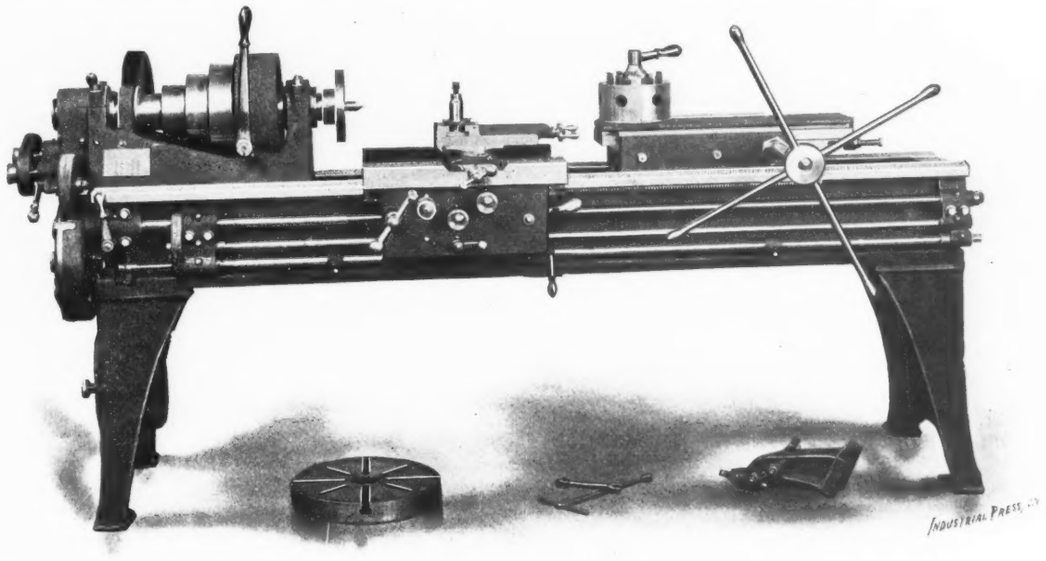


Fig. 2. Details of Caliper.

the back lash of the thrust of the plunger and its torsion keeps the key bearing on one side of its keyway, which prevents the pointer shifting on account of some looseness in the key fit.

When in use the gage is held with the handle *K* resting in the palm of the hand and the thumb and forefinger grasping the thimble, the other fingers being on sleeve *E*. In this position the thimble is easily and quickly operated. All adjustment for wear except that taken care of by the spiral spring, is made by shifting the pointer on the plunger which is done by loosening the clamping screw binding it.



Springfield "Ideal" Lathe with Turret Attachment.

The company propose to make this caliper with small points for measuring metals and also with differently graduated dials, some in ten-thousandths of an inch, and others to correspond to different wire gages.

"IDEAL" LATHE WITH TURRET.

The Springfield Machine Tool Co., Springfield, O., are now building a turret attachment for their "Ideal" engine lathe and the machine complete with the attachment is shown in the accompanying illustration. This lathe is well adapted as a turret lathe. It has a hole through the spindle 1 5-16 inch

in diameter, and a friction back-geared head giving a quick and noiseless change from the direct to the back-geared drive. This feature is necessary for a turret lathe and is quite useful also for engine lathe work. This lathe with the turret attachment is recommended for shops where rapid lathe work is essential. The system used for obtaining quick changes of feeds has already been described in these columns.

* * *

CHROMITE.

Chromium is a grayish-white metallic element that, in its isolated state, is not used in the arts to any extent. Its oxide $FeCr_2O_4$ known as chromite, however, is a valuable substance that is quite largely employed in the metallurgical industries. It is used with ferro-nickel to make chromic steel. Chromium in the presence of carbon has the property of making steel intensely hard. For this reason chromic or chrome steel is used for armor plate, armor-piercing projectiles, stone crusher jaws, stamp mill shoes and for other purposes where an intensely hard, tough and strong metal is necessary. Quite as remarkable is the heat-resisting power of chromite. It is used somewhat in the manufacture of brick for basic open-hearth furnaces, and for this purpose it is probably more satisfactory than any other lining known. One basic open-hearth furnace lined with chromite bricks stood four hundred heats before it had to be re-lined. It not only stands intensely high temperatures successfully without fusing, but alternate heating and cooling do not render it friable. It is also very hard, so that the flow of molten metal over its surface wears it away quite slowly. Chromite is found in several parts of the United States, but so far, the most of it used here has been imported from Asiatic Turkey.

* * *

Correction with Regard to Cincinnati Shaper Co.'s Plant.

An error inadvertently crept into our notice, in the July issue, of the erection of the Cincinnati Shaper Co.'s new buildings being erected on Elam St. It was stated that the main works were to be 30 feet front by 290 feet deep, whereas it should have read 90 feet front by 290 feet deep.

FRESH FROM THE PRESS.

The Textile World Official Directory of the Textile Industries for 1902. Published by Guild & Lord, Boston, Mass. Office Edition, price, $2.50; travelers' edition (in thin paper and soft covers), price, $2.00.

The Directory contains a very complete index of the textile establishments in the United States and Canada. The list is arranged by location, alphabetically, under States, cities and towns, and contains a number of maps showing the location of the textile mill cities. This year's edition also contains several new features, such as the directory of the textile firms of Canada, maps of the provinces of Quebec and Ontario; also a yarn trade index. The directory should prove valuable to all those interested in the manufacture of textiles and textile machinery.

ADVERTISING LITERATURE.

Gibbens & Stream, New Orleans, La. Catalogue of mill, factory, plantation, railroad and steamboat supplies.

The Rogers & Hubbard Co., Middletown, Conn. Pamphlet calling attention to the granulated raw bone for casehardening manufactured by this company.

The Garvin Machine Co., Spring and Varick Sts., New York. Booklet containing list of second-hand machinery and tools. The company also carry in stock a large line of new high-grade machine tools.

The Fosdick Machine Tool Co., Cincinnati, O., successors to the Fosdick & Holloway Machine Tool Co., are issuing a new and very complete catalogue containing all information possible regarding their plain and universal radial drills.

The Wiley & Russell Mfg. Co., Greenfield, Mass. Pocket catalogue and price list of this company's products. These include screw plates, tap wrenches, taps and dies, reamers, drills and drill chucks, punching presses, bolt cutters, drilling machines, etc.

The Brown & Sharpe Mfg. Co., Providence, R. I. 1902 catalogue treating of the new line of universal milling machines recently placed on the market by this company. These machines are made in sizes Nos. 1½, 2 and 3, and their distinctive features are fully described and illustrated.

The J. Stevens Arms & Tool Co., Chicopee Falls, Mass. Copy of their arms catalogue, in which all the company's products in the firearms line are fully illustrated and described. This company also manufacture a large line of mechanical tools and the Stevens-Duryea automobile.

The Northern Engineering Works, Detroit, Mich. Catalogue No. 15 of the electric traveling cranes manufactured by this company. Also pneumatic cranes and hand-power traveling cranes. Besides these they make double-hook cranes, single fixed hoist electric cranes, fixed hoist travelers, ladle cranes, yard gantries, etc.

The Morse Chain Co., Trumansburg, N. Y. Pamphlet descriptive of the "Morse silent running chain," which can be used where belt drives are not feasible owing to short centers, heat, dampness or other unfavorable conditions. The construction of the Morse chain is fully described and illustrated in the catalogue.

The W. F. & John Barnes Co., Rockford, Ill. Catalogue No. 58 of metal working machinery, including drills in all sizes, belt and electrically driven, screw cutting lathes, etc. In addition to these machines they make a complete line of foot and hand power woodworking machinery, and will be glad to mail a catalogue of same to anyone upon application.

The Pratt & Whitney Co., Hartford, Conn. Pamphlet treating of the company's new 10-inch toolmakers' engine lathe. Handsome illustrations show a front, an end and a rear view of the lathe, and two views of the head; and accompanying these is a full description of the various parts. This pamphlet will be sent to anyone desiring a copy.

The American Air Compressor Works, 26 Cortlandt St., New York. Booklet describing and illustrating some of the "American" types of air compressors. These include the duplex steam-actuated, single steam-actuated, the single belt-actuated, the vertical belt-actuated air compressors, and others. They also manufacture a full line of gas pumps, vacuum pumps, tar pumps, air receivers, air hoists and compressed air tools and appliances.

MANUFACTURERS' NOTES.

The Burt Mfg. Co., Akron, Ohio, have just filled an order for 28 Cross Oil filters and 3 Burt exhaust heads to go to their agency in London, Eng.

The Landis Tool Co., Waynesboro, Pa., manufacturers of universal grinding machines, are adding a story to their office and store-room, and are also building a new paint shop and stock room, 40 x 120 feet.

The Chambersburg Engineering Co., Chambersburg, Pa., manufacturers of power hammers, riveters, hydraulic machinery, accumulators, cranes and presses, are building a new foundry 40 x 150 feet to accommodate their increasing business.

Pawling & Harnischfeger, Milwaukee, Wis., state that the demand for their electric cranes and hoists remains very good. They send us a partial list of their recent sales, which contains the names of thirteen prominent firms.

J. L. Osgood, formerly manager of the Pratt & Whitney Co., Buffalo branch, is now engaged in the machinery business, with offices at No. 131 Erie County Bank Building, Buffalo, N. Y., and store rooms at Wells and Seneca Streets.

The Hendey Machine Co., Torrington, Conn., are to build an extension to their present shops. The new structure will be 63 x 130 feet, three stories high, with a tower 25 feet square, five stories. It is expected the new building will be ready November 1st.

The Ashcroft Mfg. Co., 85-87-89 Liberty St., New York City, are advised that the Tabor steam engine indicator has been adopted by the Philippine Insular Government as their standard on Class "A" cruisers, fifteen of which have been equipped with these well-known indicators.

The American Screw Co. have chosen Samuel M. Nicholson as Executive Head of their company. Mr. Nicholson is President and General Manager of the Nicholson File Company, the largest file and rasp concern in the world, which controls six large plants, with home offices at Providence, R. I.

The Carlin Machinery & Supply Co., Allegheny, Pa., have just completed a large shipment of machine tools to the National Cable & Wire Company, at Shousetown, Pa., who are fitted up to make insulated wire and copper cables for telephone and other purposes requiring that class of goods.

The Emmert Mfg. Co., Waynesboro, Pa., have just finished an addition to their shop which will give them about twice the room heretofore at their disposal for the manufacture of their universal vises; and have recently let contracts for two additional shops which will furnish them with still more extended facilities.

The Westinghouse Electric & Mfg. Co., Pittsburg, Pa., have recently sold to the Lunkenheimer Co. a large number of Westinghouse induction motors for the equipment of their new works at Cincinnati, Ohio. Also to Jacob Miller, Sons & Co., Philadelphia, a 180 K. W. Westinghouse 2-phase belted alternator, complete, with direct exciter.

The Woodward & Powell Planer Co., Worcester, Mass., announce that from Friday, August 8th, to Tuesday morning, August 19th, they will close their works for their annual vacation and repairs. They request that any urgent requirements of their customers be anticipated as much as possible and that orders be sent in at once to enable them to fill them.

The Woodward Governor Co., Rockford, Ill., was incorporated on June 28th last. The following officers were elected: A. W. Woodward, president; E. E. Woodward, vice-president and general manager; and J. Chas. Young, secretary and treasurer. The company are engaged in the manufacture of governors and expect to greatly increase their already large territory.

The Standard Roller Bearing Co., Philadelphia, Pa., have recently purchased the complete plant and equipment of the Roller Bearing & Equipment Co., Keene, N. H., and as soon as practicable will move the machinery and business to their new Philadelphia factory now in course of erection. They also recently purchased the business of the Grant Roller Bearing Axle & Wheel Co., Cleveland, O.

The Diamond Drill & Machine Co., Birdsboro, Pa., whose foundry was recently destroyed by fire, state their ability to fill all orders with little delay, and are entering new orders for immediate filling. They are rapidly starting a foundry in the buildings just completed for their steel casting plant, and will make grey iron castings in these until a new building can be erected for their iron foundry.

The Standard Roller Bearing Co., Philadelphia, have purchased land near the City Hall, where they will erect a large factory for the manufacture of their roller bearings. It will be 200 feet long and from 100 to 150 feet wide. We are informed that the Ball Bearing Co., recently removed from Boston to Philadelphia, will occupy a portion of the Standard Co.'s new building.

The Dayton Pattern & Model Works, Dayton, O., are erecting a new five-story brick building 40 x 100 feet to accommodate their rapidly increasing business. They are in the market for shafting, hangers and belting and some new machinery, including a dynamo for lighting purposes. They also want an outfit for producing gas from crude petroleum.

Westinghouse, Church, Kerr & Co. announce the removal of their Pittsburg office from its former location on the first floor to the eighth floor of the Westinghouse building. The office conducts, as formerly, the sales department of the Westinghouse Machine Co. The official address is: Westinghouse, Church, Kerr & Co., Westinghouse Building, Pittsburg, Pa.

The Hayden & Derby Mfg. Co., 85-87-89 Liberty St., New York City, have received word that their Metropolitan 1898 injector, model "O," has been adopted by the Philippine Insular Government as the standard on their class "A" cruisers. The contract was secured by F. W. Horn & Co., Yokohama, Japan, who are the agents for the Hayden & Derby Mfg. Co. at that point.

The Cleveland Pneumatic Tool Co., Cleveland, Ohio, will at once begin the erection of modern factory buildings on Hawthorne and Second Avenues, having outgrown their present shop space, and being unable to keep up with their orders. They will employ about 150 men in their new plant, and hope then to be able to serve the trade more promptly. Electrical power will be used in driving the machinery.

The Philadelphia Pneumatic Tool Co., Philadelphia, Pa., have concluded arrangements for representation in South Africa with headquarters at Johannesburg. This agency will be in charge of General Samuel Pearson, late of the Boer forces. General Pearson has been in the United States for some months in the interests of his government, but declared he will return to his former business and handle the accounts of the Philadelphia Pneumatic Tool Co. and others.

THE LARGEST MECHANICAL CIRCULATION IN THE WORLD.

U.S. Shop W. empl. no. 4. el. pub.

DOMESTIC EDITION.—ADVERTISING INDEX PAGES 19-21.

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VOL. 8. AUGUST, 1902. No. 12.

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Accuracy, Durability and Workmanship.

Made in all styles and sizes and for every purpose. Special Cutters to order. Gangs designed.

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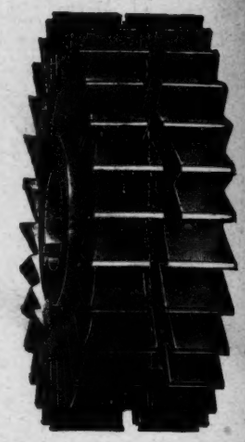

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AIR COMPRESSOR

Like our IMPERIAL TYPE 11 this is an entirely NEW design, not an old machine remodeled. Contains many good features.

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The Fellows Gear Shaper

is not an experiment. Two years of test has proved that it is not only theoretically correct, but is practically the most efficient Gear cutter on the market. Ask the

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WE MAKE BOTH CRANK AND GEARED

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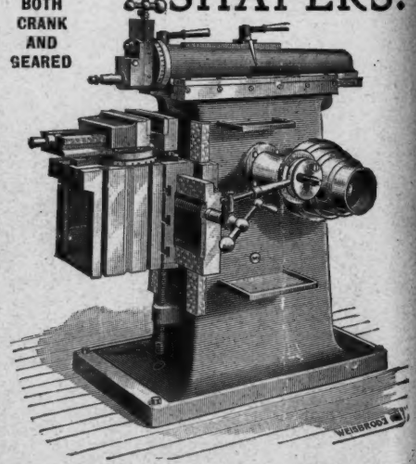

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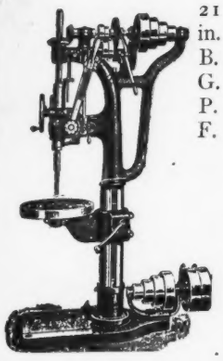

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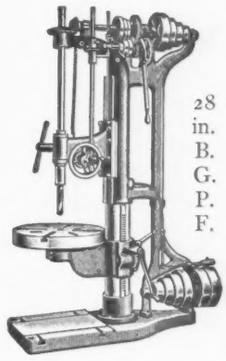

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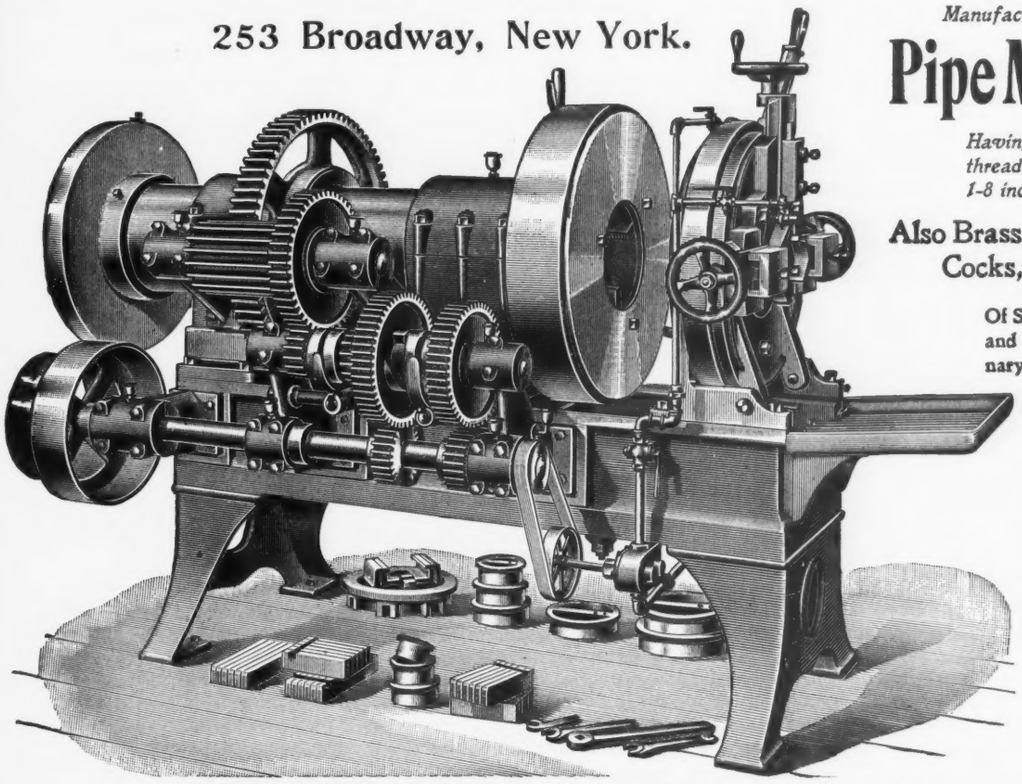

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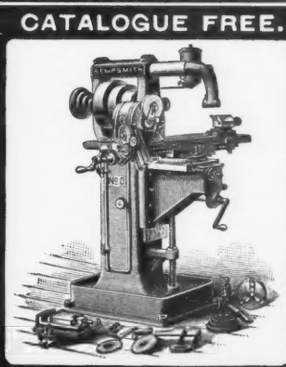

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Kempsmith Product has

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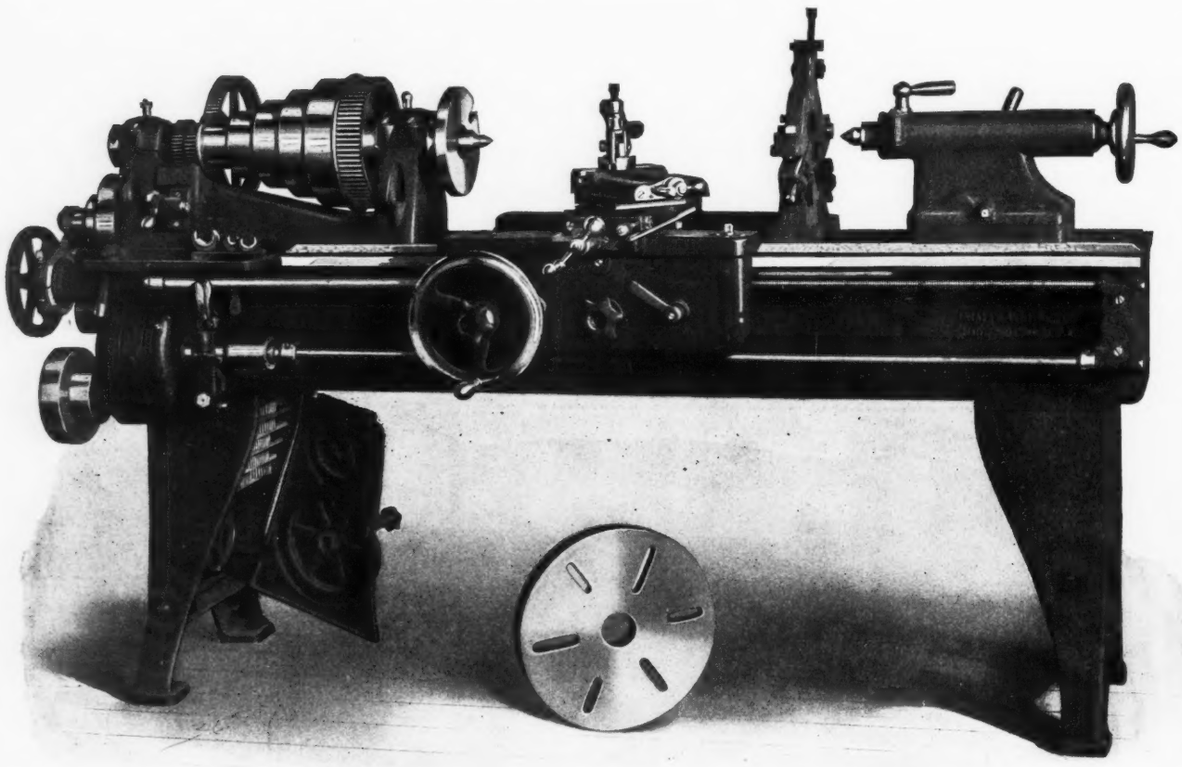
14-inch LATHES.

IN STOCK FOR IMMEDIATE DELIVERY.



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A new model Gibbed Carriage Engine Lathe, swinging 15 7-8 inch over shears, especially designed for tool-room use.

The longitudinal and transverse alignments are practically perfect, all bearings have great length and surface and are scraped to fit. Special attention is called to the bed, which is of box form, giving greatest resistance to bending and torsional strains.

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DRAW-BACK COLLET MECHANISM:—Is furnished to order with nine collets ranging from 3-8 inch to 7-8 inch by sixteenths.

STEP CHUCKS AND CLOSERS:—Four blank split step chucks suitable for short work from 7-8 inch to 6 inch diameter and two closers are furnished with Draw-back Collet Mechanism to order.

These attachments give to this lathe every convenience hitherto associated with Bench Precision Lathes.

Net weight is fully 25 per cent heavier than any other machine of similar size now on the market.

This lathe is recommended both on account of its accuracy and convenience for the highest grade of tool making.

Call and inspect our lathes at our Branch Offices.

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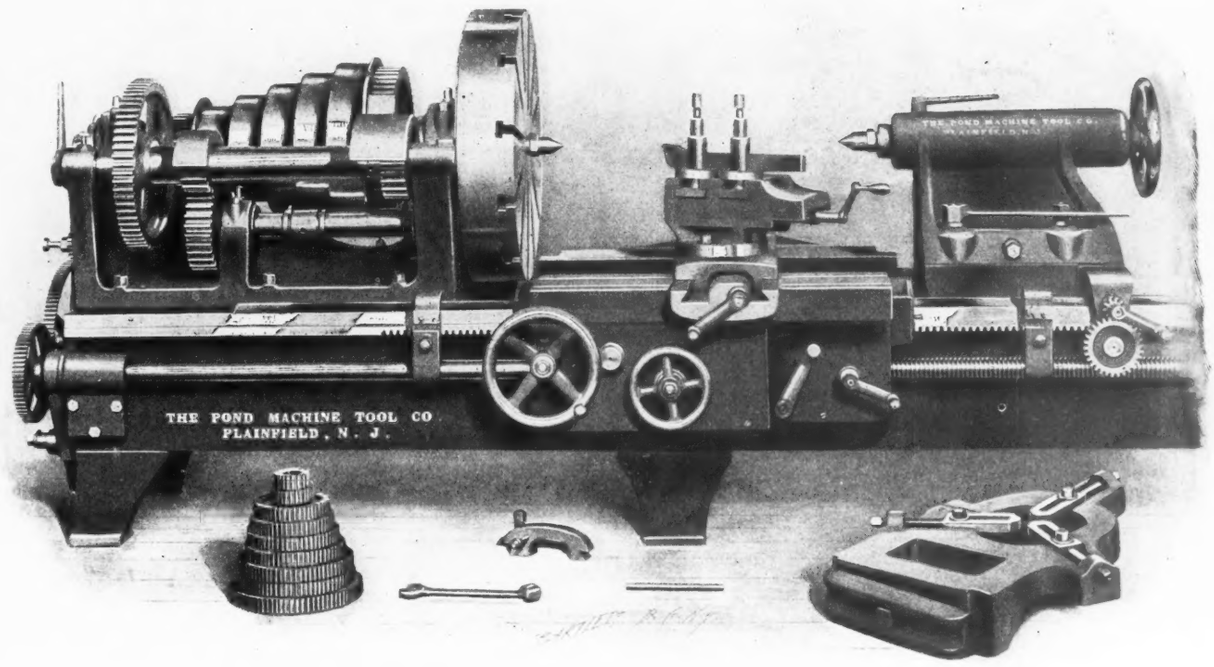

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19	3	9½	3	4¾	3	2¼	2
20	4	10	4	5	4	2½	4
22	5	11	5	5½	5	2¾	5
23	6	11½	6	5¾	6	2⅞	6
24	7	12	7	6	7	3	7
26	8	13	8	6½	8	3¼	8
28	9	14	9	7	9	3½	9
30	10	15	10	7½	10	3¾	10
32	11	16	11	8	11	4	11
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80 To 40		40 To 20		20 To 10		10 To 5	

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Sizes: 14 in , 16 in., 18 in., 20 in., 22 in., 24 in., 27 in., 30 in., 36 in , 36 in. Massive, 42 in., 48 in., 60 in. in preparation.

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...Of the MOST ADVANCED TYPES.

Slotting Machines,
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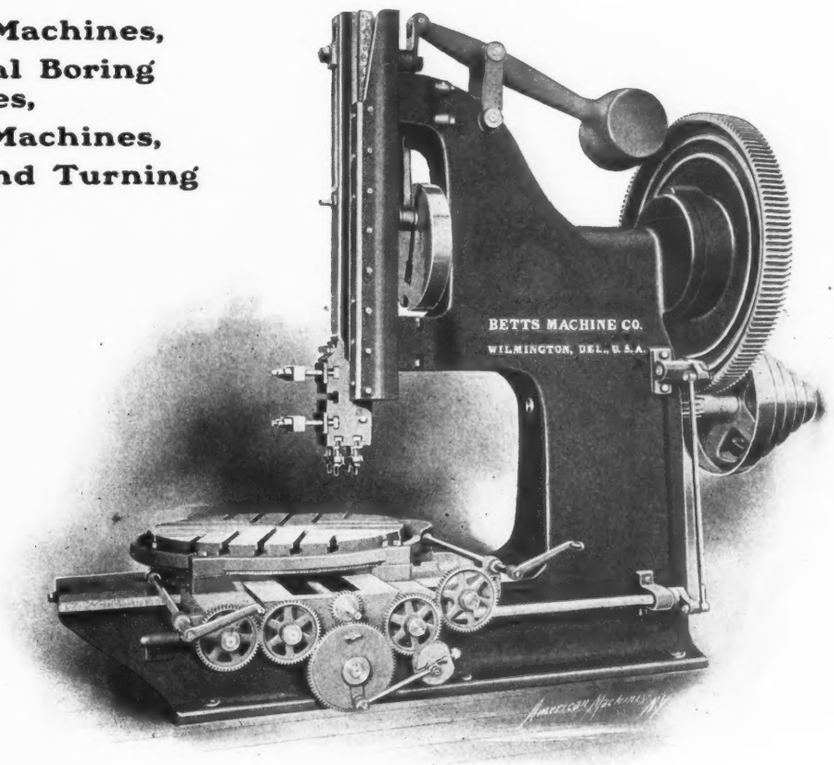

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The above cut shows the 21 inch machine. It has a stroke of 21¾ inches, with adjustment for any position and length of movement. The Cutting Bar has eight speeds, is counter-balanced, and returns 2¾ to 1. Distance from frame to front side of cutting bar is 42 inches, making it possible to slot in center of 88 inches. Feeds are positive, self-acting in all directions, and operate at upper end of stroke; the arrangement of handles and other feed works is such that the operator can command full use of them from one position, and at the same time watch the cutting tool. Compound Table has an adjustment of 48 inches longitudinally, and 44 inches transversely, and supports a revolving table 48 inches in diameter, secured in any position by corner clamps. This table is graduated, and so arranged that the worm can be disengaged for ready adjustment of work.

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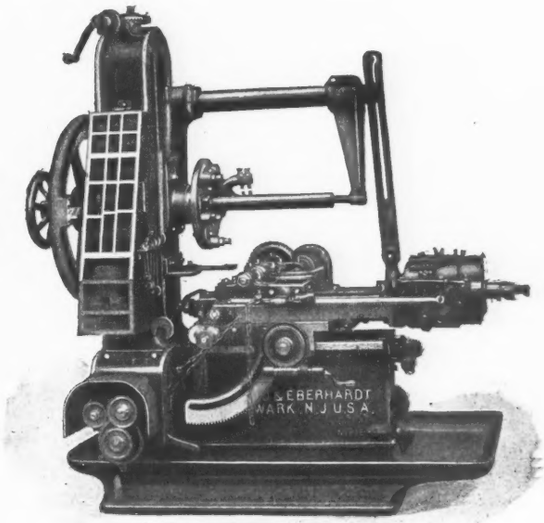

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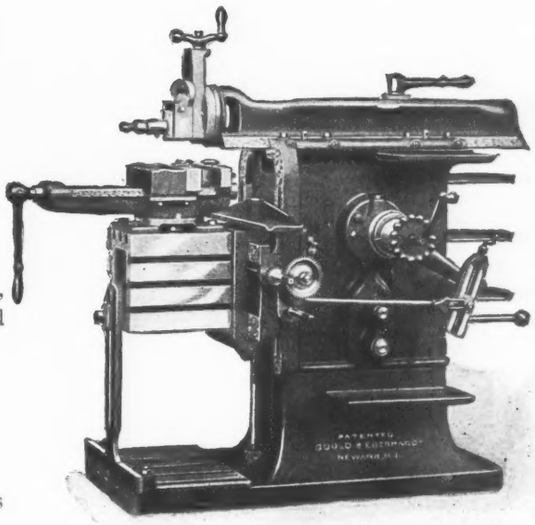
14″ to 32″ stroke.



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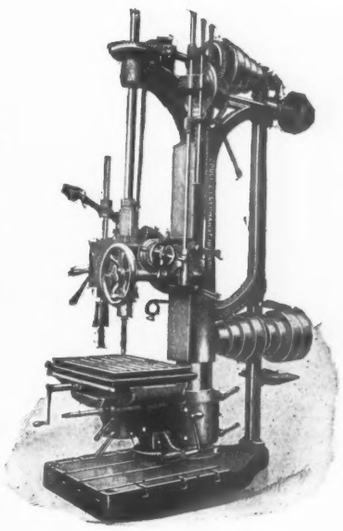

You may, perhaps, find them a trifle higher in price than some others, but there's a good reason for it—the **QUALITY** will be remembered long after the price is forgotten.

QUALITY means good work and long service, and in our machines also means that you get the maximum amount of service with a minimum of expense.

It's not what you pay, but what you get for what you pay that counts. And what you need is **QUALITY**—the Gould & Eberhardt kind.

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is best determined from what the man who buys it, and uses it, says. We have undeniable proofs along these lines which testify to the unequalled merits of

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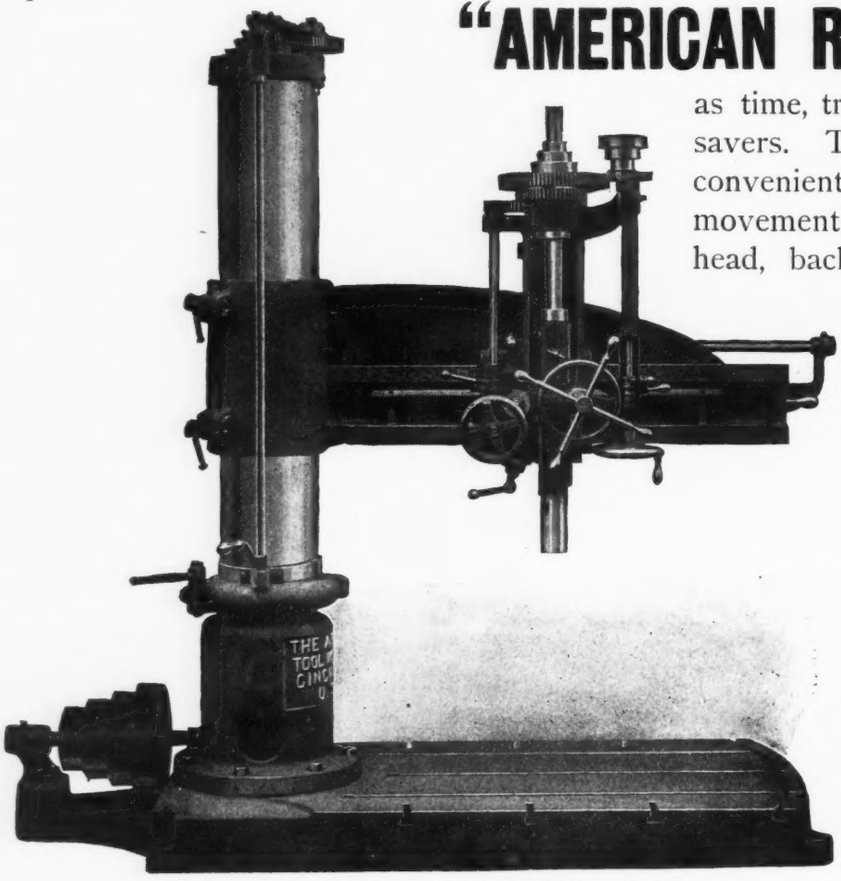

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as time, trouble and money savers. They are rapid and convenient in operation—all movements of the spindle, head, back-gears, and tapping attachment are under instant control of the operator without change of position.

Their inherent strength, and the excellence of material and workmanship used in their construction, render them exceptionally durable and reliable in hard and continuous service.

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THE KIND THAT CUT, NOT ONLY CUT, BUT CUT FAST.

THIS IS THE BLADE

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THESE ARE STIFF BLADES TEMPERED ALL OVER LIKE A FILE OR MILLING CUTTER.

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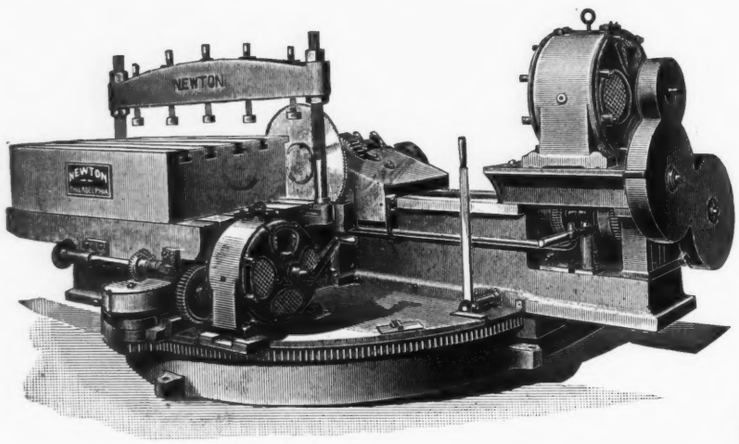

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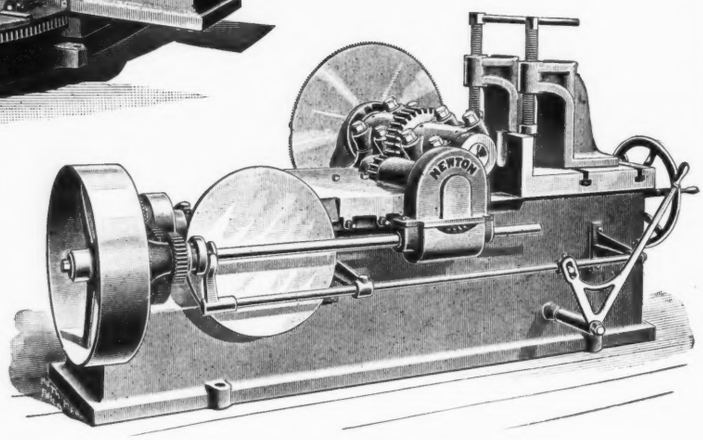

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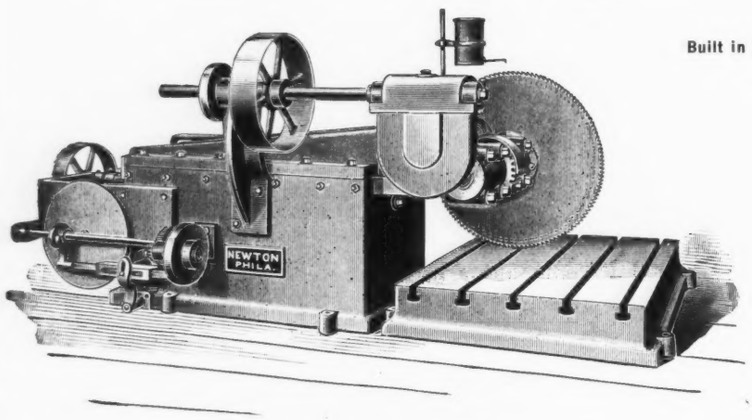

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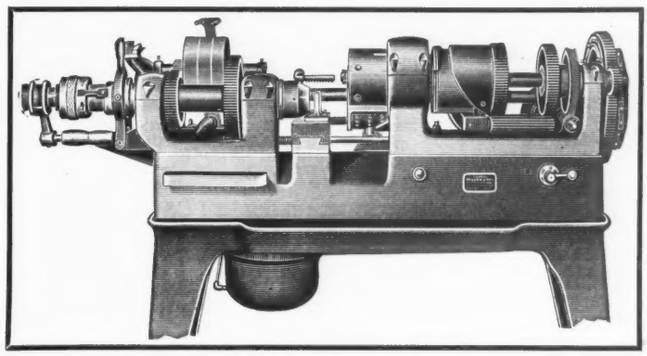

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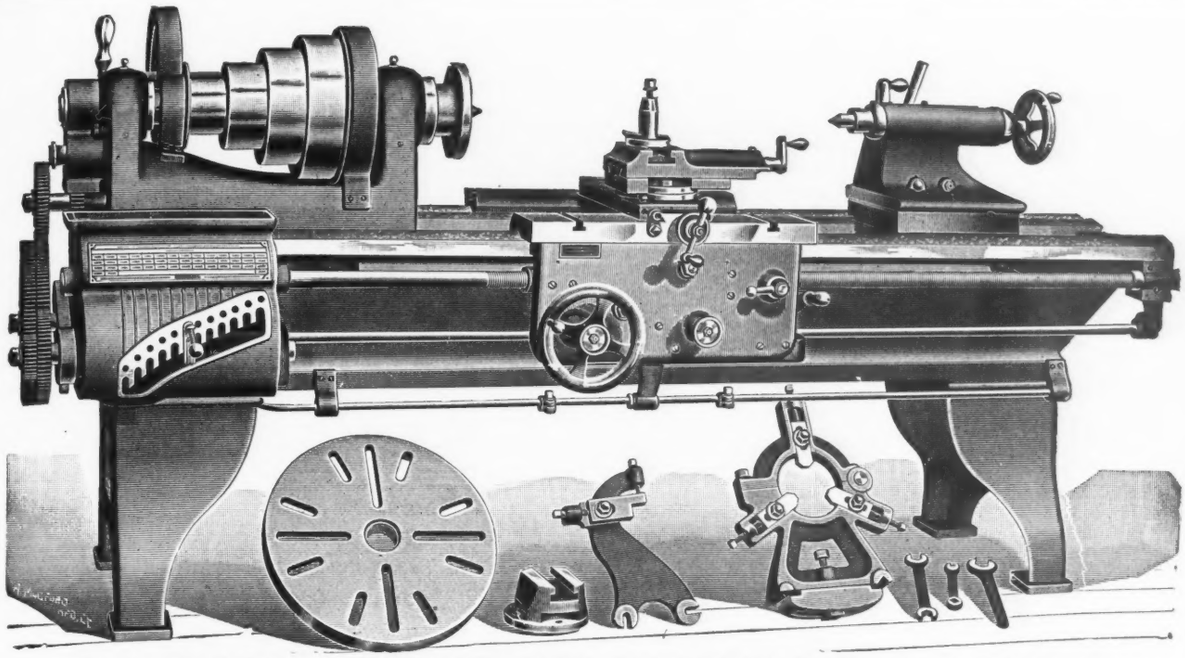

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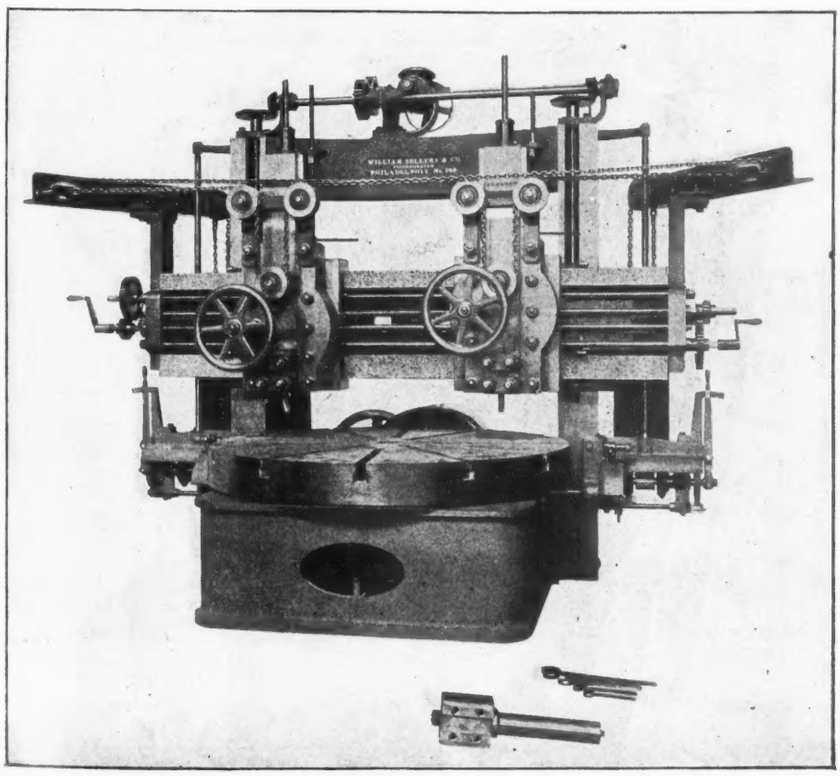

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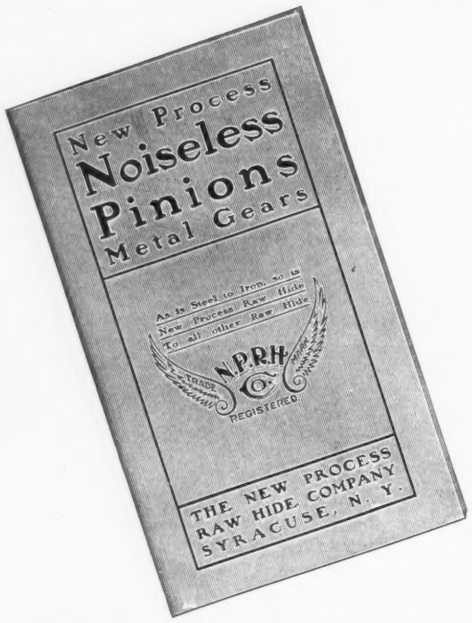

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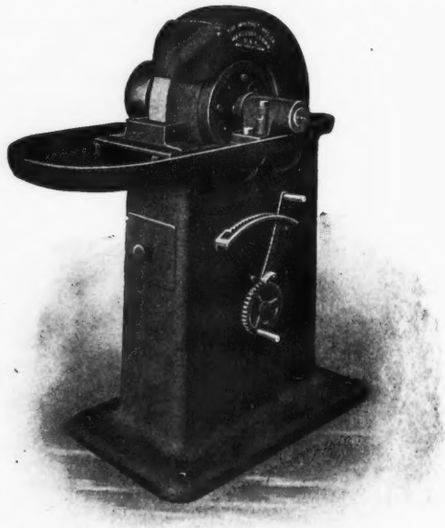

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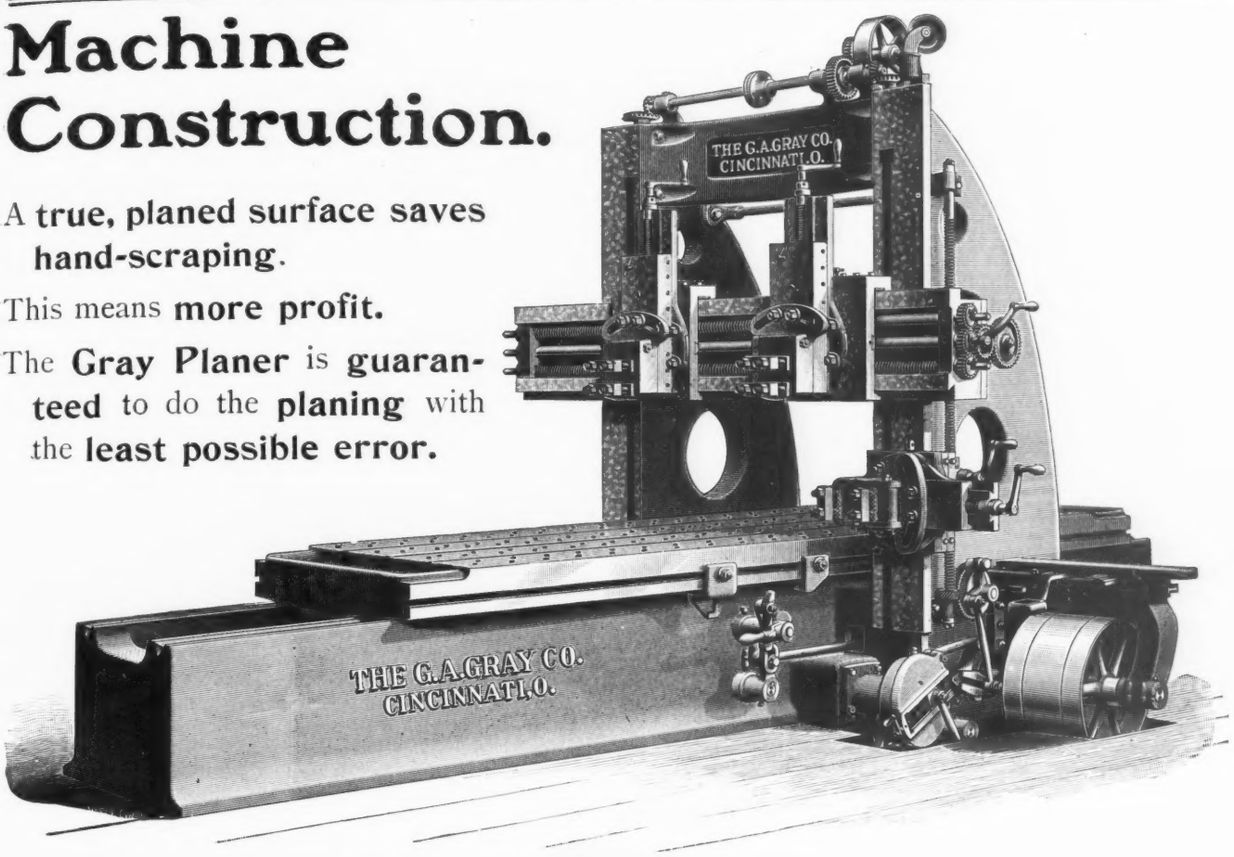

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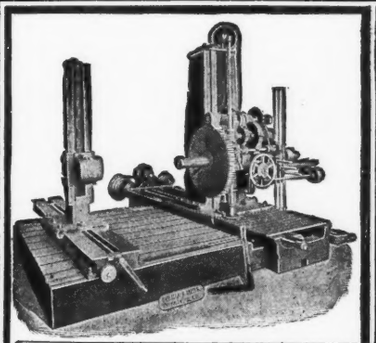

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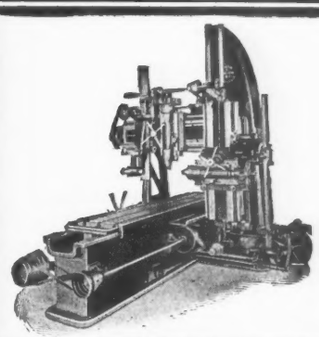

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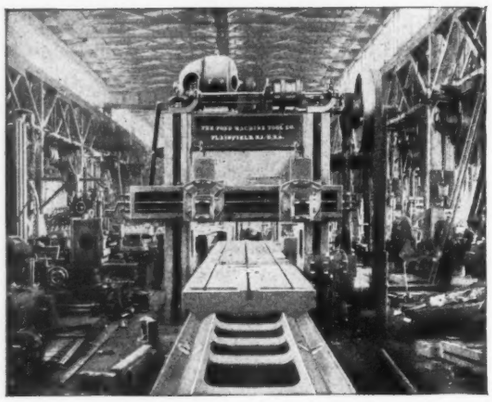

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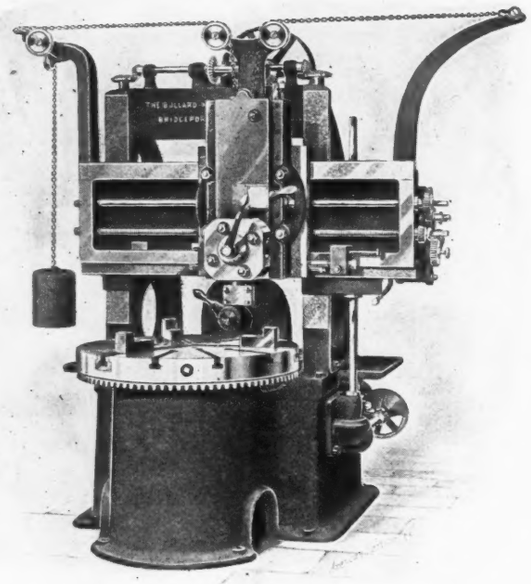

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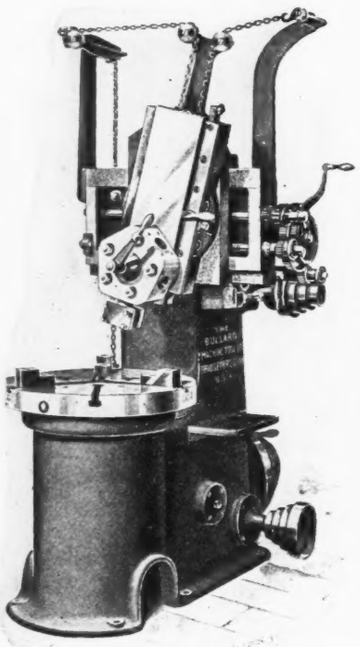

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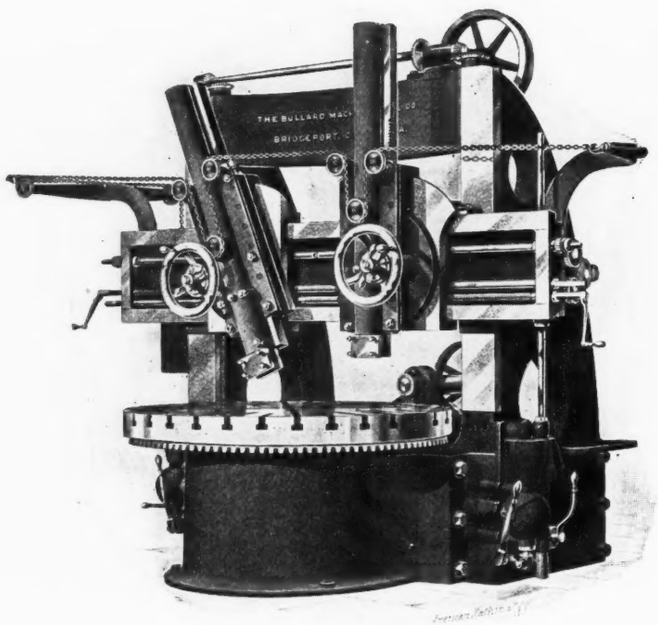

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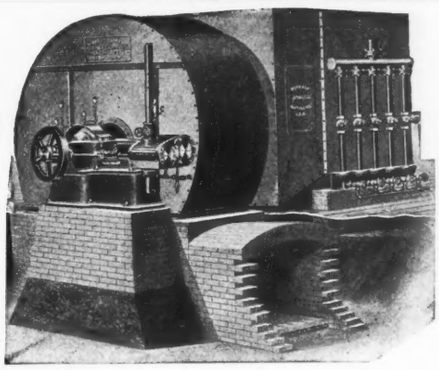

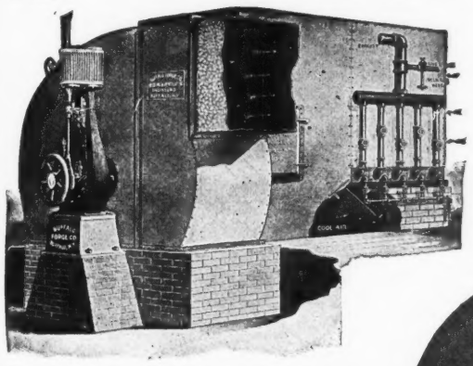

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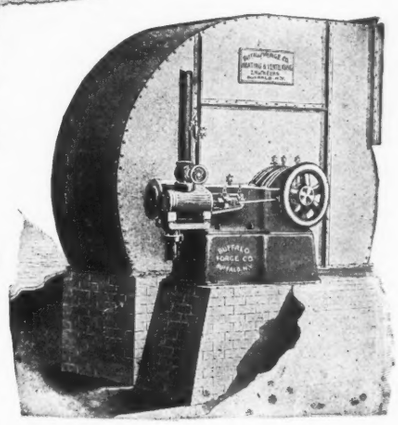

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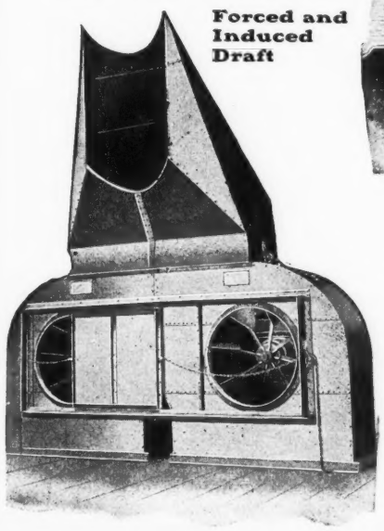

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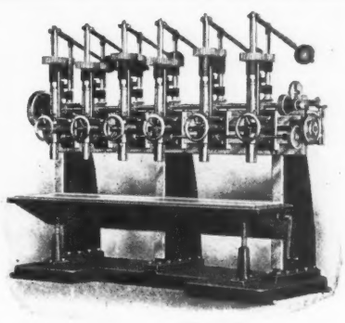

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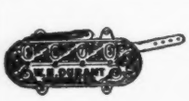

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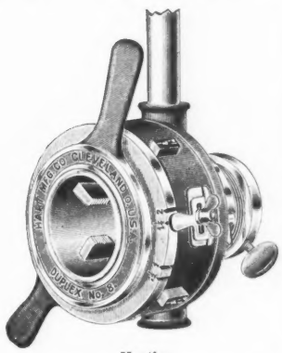

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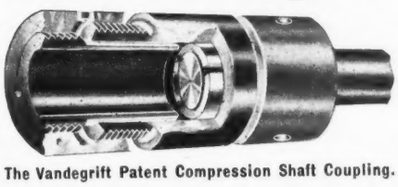

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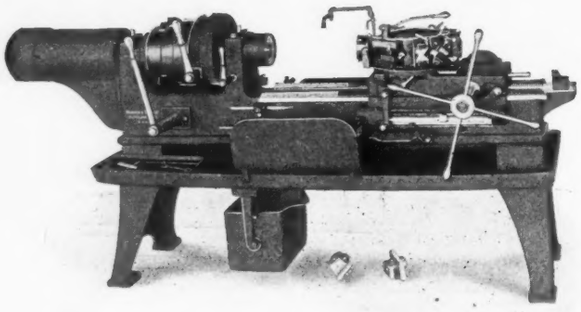

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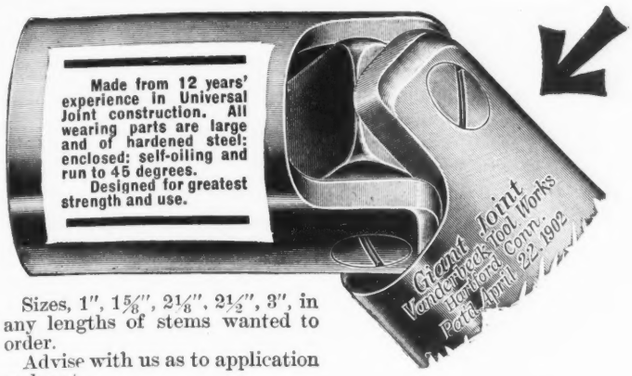
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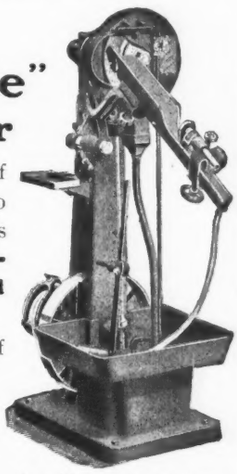

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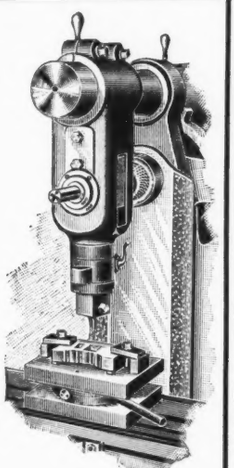

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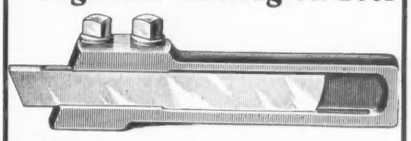

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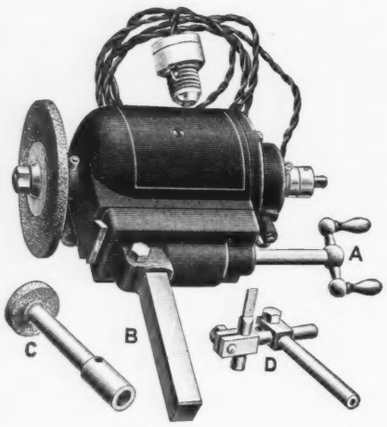

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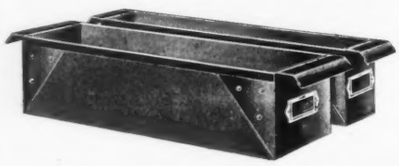

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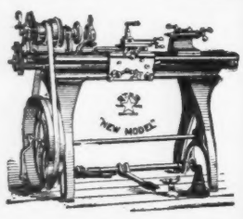

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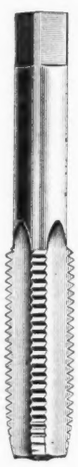

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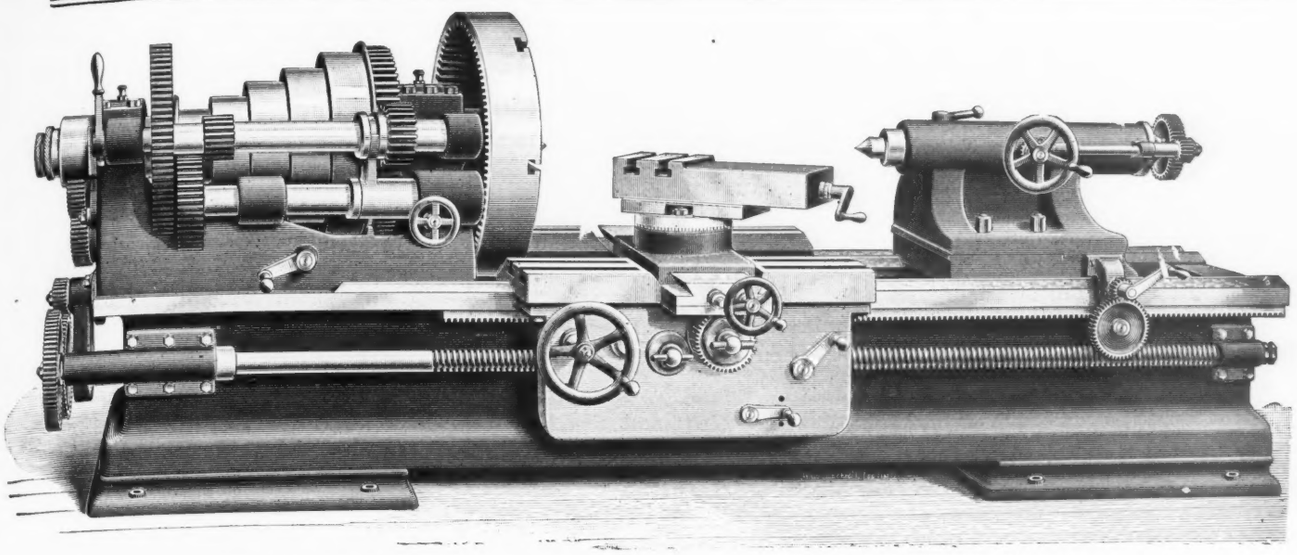

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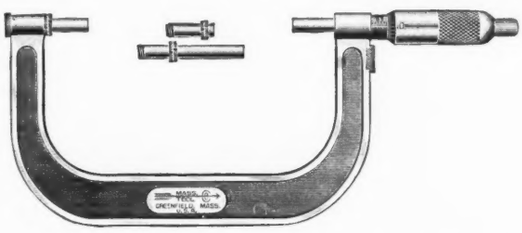

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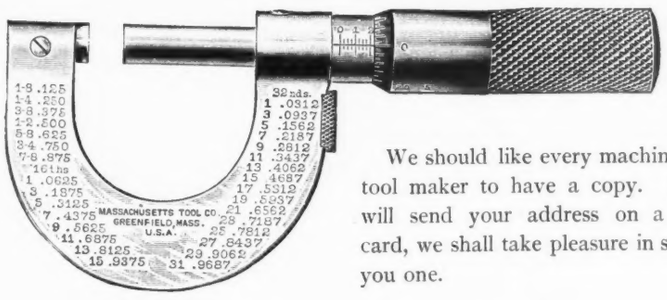

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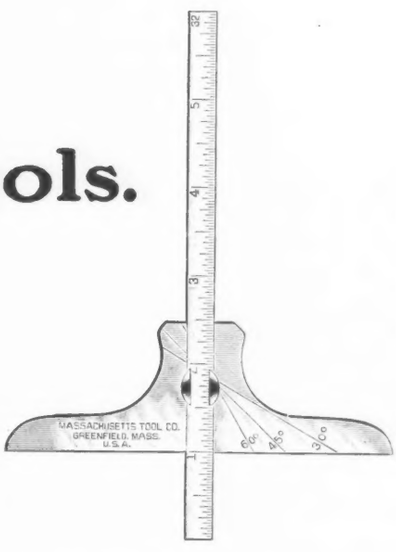

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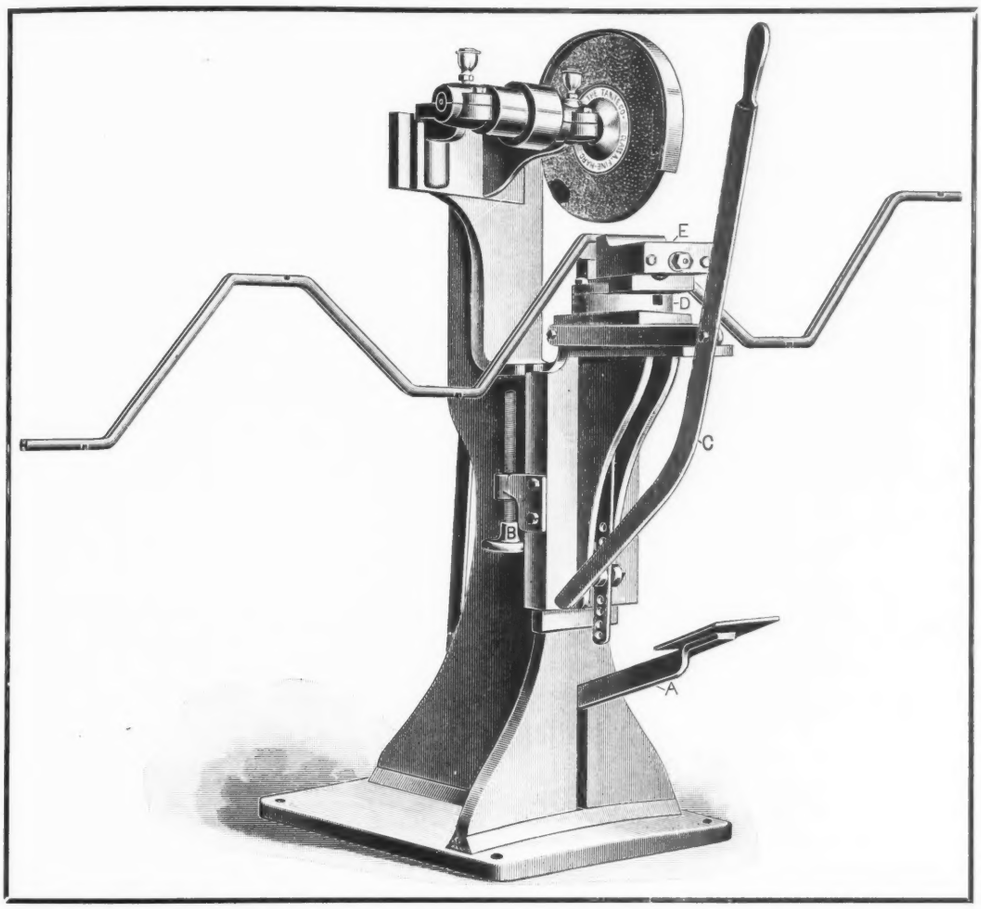

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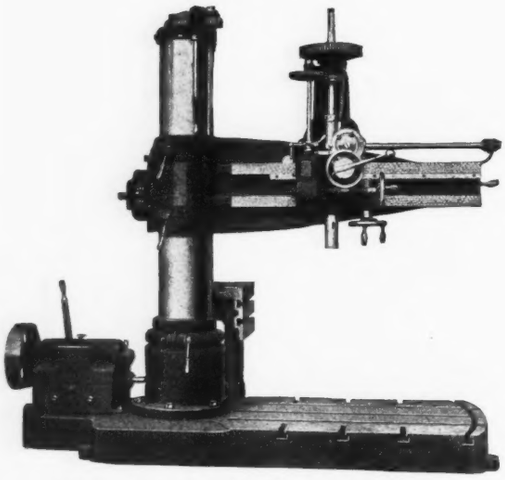

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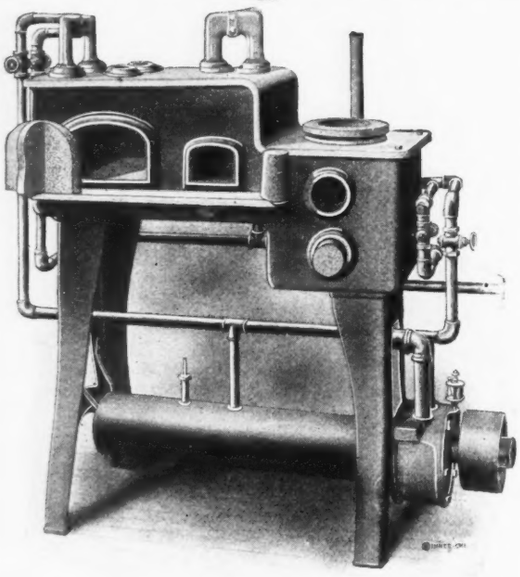
FOREIGN AGENTS: Schuchardt & Schutte, Berlin, Cologne, St. Petersburg, Vienna, Stockholm, Brussels and New York. Adphe Janssens, Paris, France. Charles Churchill & Co., Ltd., London, Birmingham, Manchester, Newcastle-on-Tyne and Glasgow. F. W. Horne, Yokohama, Japan.

A Triplex Gas Furnace



This unique furnace combines on one base the three most useful furnaces for tool room or machine shop work. Actually **three in one**—a Muffle Furnace for heating and hardening small tools of all descriptions; a Forge Furnace where steel may be heated for forging purposes, and a Crucible Furnace, useful for tempering small pieces or melting babbitt, as occasion requires.

The Stewart Combination Gas Furnace

heats uniformly and quickly any piece or pieces that will go into its various openings, effecting a saving in time alone, over other methods, that more than pays for the fuel consumed. Compact, convenient and reliable; can be started instantly and covers a range of work that renders it practically indispensable.

SEND FOR OUR CATALOG OF GAS BLAST FURNACES.

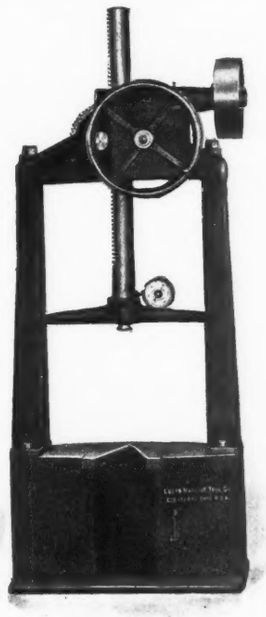
Chicago Flexible Shaft Co., **La Salle Ave. & Ontario St. Chicago, Illinois.**

FOREIGN AGENCIES: Niles Tool Works, 23-25 Victoria St., S. W. London. Fenwick Freres, 21 Rue Martel, Paris. Gustav Diechmann & Sohn, 32 Neue Promenade, Berlin.

SOMETHING NEW

The Lucas Power Forcing Press

A step between the hydraulic and hand press and better than either on work within its range



Powerful
Simple
Unique
Effective
Thoroughly tested and in use in some of the best shops

The belt does the work
The Operator applies and controls it only

Made in 3 sizes taking diameters of 24, 30 and 36 inches.

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FOX WOOD TRIMMERS

No. 4 A Cut 4 in. high or 8 in. long.

REDUCE THE COST OF PATTERNS.

TEN SIZES.

THAT an equipment of Fox Trimmers saves a great deal in Pattern Work should not need any proof by this time.

HOWEVER, we stand ready to send them on trial leaving it to the tools themselves to prove their value in actual work.

No. 3 Miller.

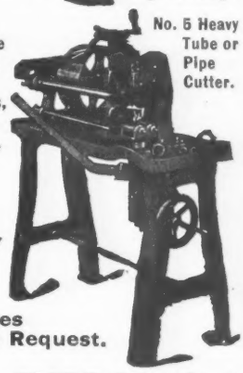
HAND AND POWER FEED.

NO. 6 E.

Cut 6 in. high or 36 in. long.

Multiple Spindle Drills, Shapers, Planer Chucks, Etc.

No. 5 Heavy Tube or Pipe Cutter.



Hand Rack Feed, Hand Screw Feed and Power Screw Feed.

Line in stock by J. W. Cregar Agency "The Bourse," Philadelphia.

Catalogues on Request.

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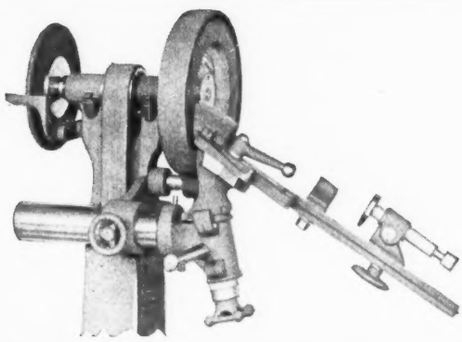

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For Wet or Dry grinding. For Little or Big drills. Electrically, Belt or Air driven.

Tell us your requirements; we will guarantee results.

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Worcester Polytechnic Institute,
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This is the only complete pocketbook designed exclusively for mechanical engineers. It should be owned by everybody who has anything to do with machinery. It is kept up to date by frequent revisions, and is too well known to need a description Price, $5.00. THE INDUSTRIAL PRESS, New York.

The Variety of Purposes to which

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can be adapted, and their effectiveness in maintaining and increasing available power under the most severe conditions are unassailable points in their favor. We are equipped to build Power Transmission Machinery of any capacity embodying the Hyatt Roller Bearing, and shall be glad to give an estimate on your work.

Special Bearings designed.

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Billings Patent Adjustable Wrenches

Are Popular the World Over.

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All are drop forged from Bar Steel and finished Black or Full Nickel Plated.

DROP FORGINGS of every description and for all purposes.

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Astonishing Tapping Savings

Our Patent Geared Tapping Attachment is showing results even better than we anticipated. Through its use tapping costs are cut away down.

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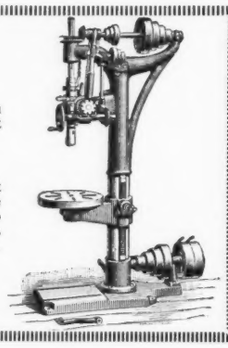
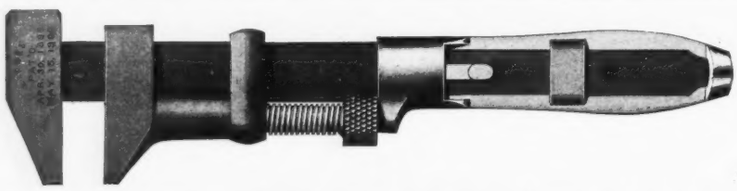
who visited us this week was so impressed with this attachment that he offered the suggestion that we build all standard machines in the future with this arrangement, leaving the old style regular drill to be a special to be made only on order, which suggestion we think is not half way bad. We should like to demonstrate the same to you.

CINCINNATI MACHINE TOOL COMPANY,
WESTERN AVE. & FRANK ST., CINCINNATI, OHIO, U. S. A.





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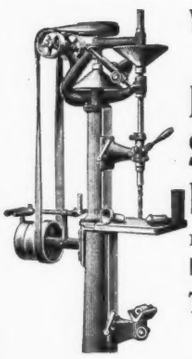

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is what you get when you buy a
Knecht Friction Sensitive Drill Press. Write for new booklet No. 10.
It is a great saver of
Drills, Worry and Labor.
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Design and build AUTOMATIC and SPECIAL MACHINERY of all kinds. Inventions perfected. We also build Metal Planers.
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DESIGNERS AND BUILDERS OF SPECIAL MACHINERY DESCRIBED IN CATALOGS.

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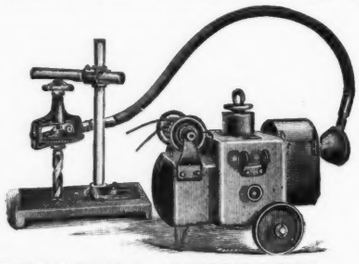
PORTABLE DRILLING, TAPPING, REAMING, ETC.



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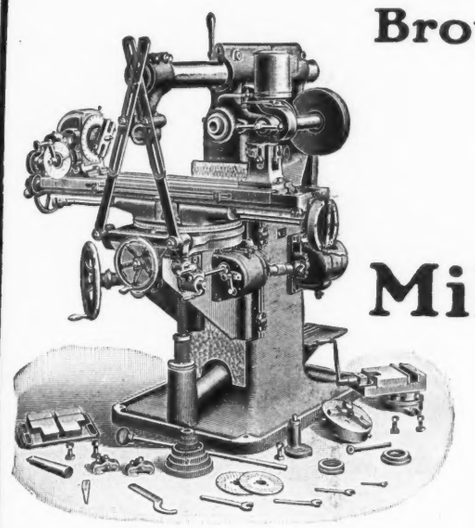

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Universal Milling Machines.

Nos. 11-2, 2 and 3.

Distinctive Features.

Spindle Speeds—Correct for the most advantageous and economical operation of the machine. Changes in Geometrical Progression.

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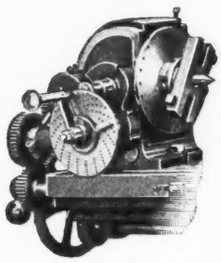


New Method of Indexing—Allows All Divisions from **1 to 360** to be made with Change Gears Furnished. As Simple as Plain Indexing.

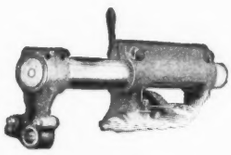
Spiral Head Exceptionally Rigid, Full Width of Head for Bearing, As Rigid in Vertical Position as in Horizontal.

All Levers for Controlling Various Feeds Conveniently Located at Right of Knee. One Lever Serves to Start, Stop or Reverse All Feeds.

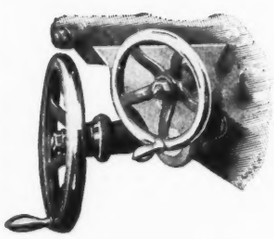
Table Feed Trip of Double Plunger Type—Sensitive, Convenient.

Capacity for Automatically Cutting Spirals Greatly Increased.

Table Feed Screw—Not Splined.



Overhanging Arm—Solid Steel Bar Efficiently Clamped at Both Bearings by **One Lever.**



Fixed Hand Wheels—More Convenient than Cranks; Any Two Feeds can be Operated Simultaneously.

All Working Parts Carefully Protected—Cast Iron Guards Used Where Possible.

Special Pamphlet, Describing Features in Detail, Mailed to any Address.

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MISCELLANEOUS.

Advertisements in this column, 25 cents a line, ten words to a line.

The money should be sent with the order.

A MANUFACTURING CONCERN in Northern Ohio thoroughly equipped with entirely new plant for turning out light or medium weight tools of any character suitable for machine shop trade, would like to correspond with parties desiring same manufactured on royalty. Address MANUFACTURER, 9-15 Murray St., New York.

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INVENTOR'S MODELS built and perfected, special machinery designed and built, small parts duplicated. Let us quote prices. F. J. STOKES MACHINE CO., Philadelphia, Pa.; New York representative, FRANK P. WISNER, 46 Cliff St.

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SWEDISH-AMERICAN FOREMEN.—Wanted—Two first-class Swedish-speaking machine shop foremen; well up to date in modern shop practice. Apply in Swedish, stating age, experience and wages expected. Address AKTIEBOLAGET SEPARATOR, Stockholm, Sweden.

TO EXPORTERS OF MACHINERY TO RUSSIA.—The Toula Manufacturing Company, Limited, at Toula, in Central Russia, beg to inform American makers and engineers, who might be desirous of having their products manufactured in Russia itself, that they are prepared to undertake any orders that might be intrusted to them. The Toula factories include a cast-iron and steel foundry and newly fitted-up works with all the most modern appliances, including a large quantity of American machine tools, for constructing machinery of every description. The arrangement enables the company to undertake, under the most favorable conditions, the manufacture of all descriptions of machinery, machine tools, agricultural machines and specialties of all kinds. Address communications to: LES ATELIERS DE TOULA, SOCIETE ANONYME, 299 Chaussée d'Anvers, Brussels, Belgium.

WANTED—First-class detail draftsman, experienced on machine tool work; factory 100 miles from Chicago; a first-class man who can command good pay only wanted; married man looking for steady position preferred. Address DRAFTSMAN, care of MACHINERY, 9-15 Murray St., New York City.

WE DESIGN and make automatic machinery and special mechanical devices. Do all work in connection with the development of mechanical inventions. Engineering, designing, drafting, machine construction, models, tools, and also attend to job work and repairs. Address CHAS. E. HADLEY, Mechanical Engineer and Machinist, 584 Hudson St., New York, N. Y.

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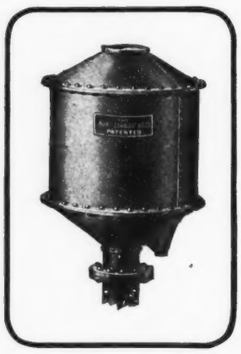

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will prevent rotting roofs, disfigurement of buildings, and expensive repairs; also makes the exhaust noiseless. Adopted by the British and United States Governments, and now in use by many of the most prominent firms in this country and in Europe—among these are

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Messrs. Vicken, Sons & Maxim, Sheffield
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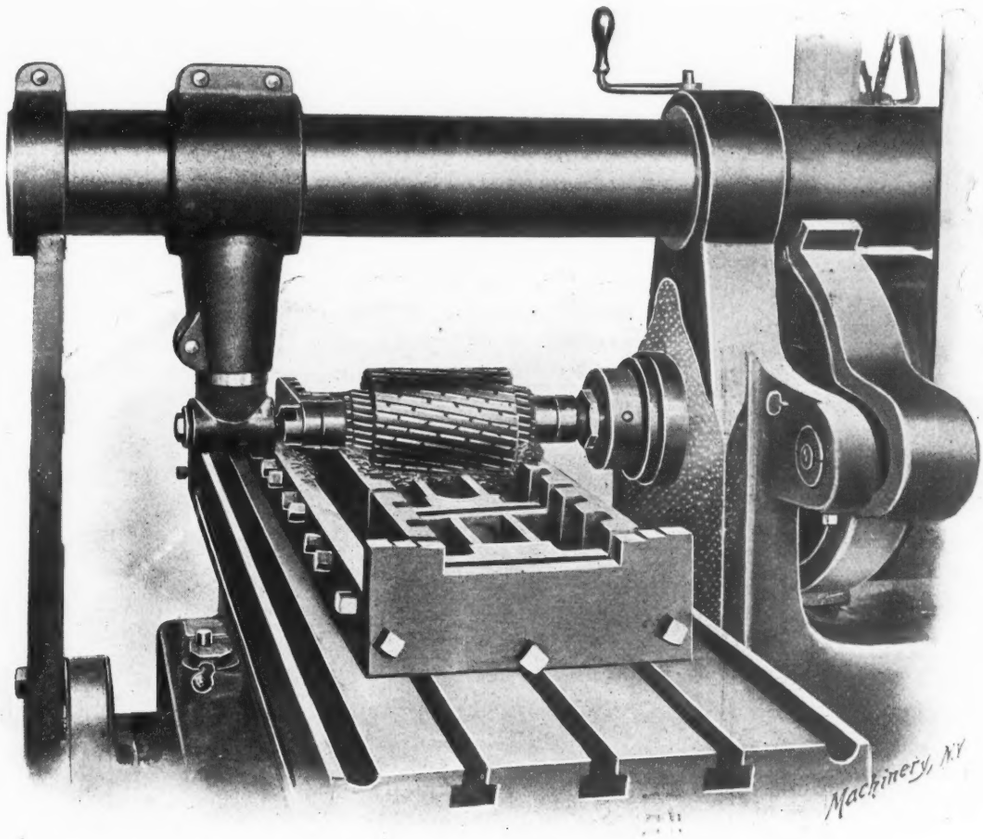


The Productiveness of Cincinnati Geared-Feed Millers

is thoroughly demonstrated by this one operation of finishing cast iron bearing surfaces 7⅝ in. wide by 15-16 in. deep to gage.

The largest cutter in the gang is 4½ in. diameter and 6 in. face and works at a cutting speed of 47 feet.

The roughing cut takes out about 3-32 in. all around to remove scale at a feed of .075 in. per turn of cutter, which is equivalent to a table travel of 3 in. per minute.

Don't you think it requires a powerful feed drive to pull a cut like that and an exceedingly rigid machine to stand such a strain? Both these features are characteristic of Cincinnati Millers.

When the roughing cut is completed the outer support is swung clear of the arbor and the roughing cutters are replaced by a set for finishing, without disturbing the overhanging arm and braces, in less time than it would take to re-chuck the pieces.

The finishing cut removes about .010 in. all around at a cutting speed of 47 feet and a table travel of nearly 1½ in. per minute.

These pieces are 7 in. long; the finished surface is of irregular outline 7⅝ in. wide by 15-16 in. deep.

Don't you think it would pay you to do some of your work on a "Cincinnati" Miller?

Ask for our 1902 Catalogue and look out for another money saving operation next month.

The Cincinnati Milling Machine Co.

CINCINNATI, OHIO, U. S. A.

EUROPEAN AGENTS—Schuchardt & Schutte, Berlin, Cologne, Vienna. St. Petersburg, Brussels, Stockholm and New York. Adolphe Janssens, Paris. Chas. Churchill & Co, London, Birmingham, Manchester, Newcastle-on-Tyne and Glasgow. The Niles Tool Works Co., 23-25 Victoria St., London, S. W.

In the Beginning

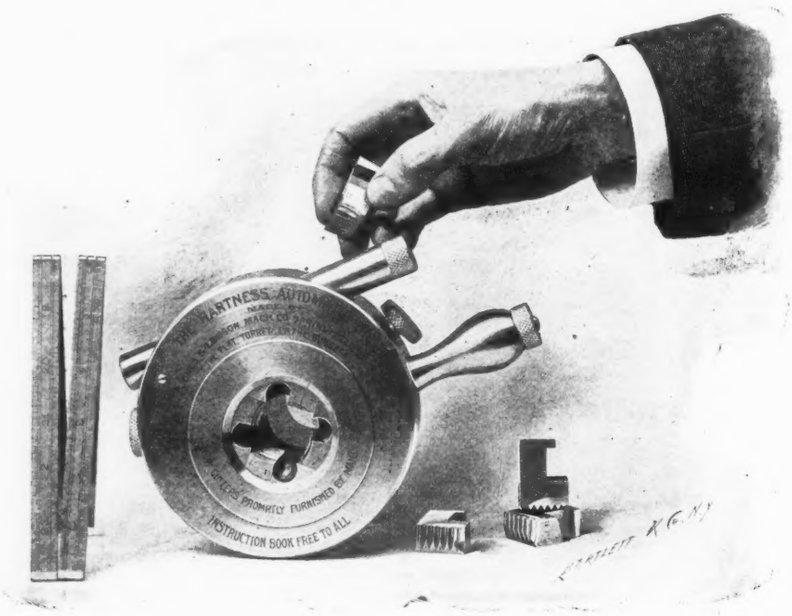
The Hartness Automatic Die was designed for use on the Flat Turret Lathe—this might be called the "raison d'être" of the die—but while originally designed for the Jones & Lamson machine it is equally useful for any turret lathe where quick operation and accurate results are required.

The Flat Turret Lathe marked a new departure in lathe work.

Its advent into the machine world made it possible to perform operations on small machine parts four or five times quicker than had been possible to do the work on an engine lathe, with results that were actually better than ordinarily obtained.

The principle of lathe work used on the Flat Turret Lathe was complete in all particulars except that of thread cutting, and to fill this deficiency the Automatic Die was designed, thus making it feasible to cut accurate threads with great rapidity on a turret lathe.

The work produced by the Automatic Die compares favorably with the ordinary results in thread cutting obtained on the engine lathe. It is made in two sizes and turns all diameters up to 2 inches. Provided with right and left hand chasers for cutting U. S. Standard, V Standard, Whitworth or Metric Standard; also half V threads.



Made by

Jones & Lamson Machine Co.

Builders of The Flat Turret Lathe

Springfield, Vermont, U.S.A.

What the I. C. S. Did for Me

When I took up the I. C. S. training, I could neither read nor write the English language, but after I had completed two-thirds of the Course I not only qualified for a position as draftsman, but also mastered the language. I am now employed as draftsman for the Pennsylvania Railroad. I heartily recommend the International Correspondence Schools to all that are anxious to advance themselves to higher positions.

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We can train you for a better position and a better salary. We have been doing it for other people for over ten years. With these years of experience behind us, why can't we do the same for you? Get particulars of our method, anyway. You'll find them interesting, and they will cost you nothing but a two-cent stamp.

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Please explain how I can qualify for position marked **X** below.

	Mechanical Engineer		Hydraulic Engineer
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	Foreman Patternmaker		Mining Engineer
	Foreman Blacksmith		Mine Foreman
	Foreman Molder		Sanitary Engineer
	Gas Engineer		Architect
	Refrigeration Engineer		Arch. Draftsman
	Traction Engineer		Sign Painter
	Electrical Engineer		Analytical Chemist
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	Electrician		Ornamental Designer
	Electric Lighting Supt.		Navigator
	Electric Railway Supt.		Bookkeeper
	Telephone Engineer		Stenographer
	Telegraph Engineer		Teacher
	Steam Engineer		To Speak French
	Marine Engineer		To Speak German
	Civil Engineer		To Speak Spanish

*Occupation*_____ *Age*_____
*Name*_____
*St. and No.*_____
*City*_____ *State*_____

We have hundreds of endorsements like the above—just as strong, just as convincing. Isn't this one convincing enough to induce you to cut out, fill in, and send us the accompanying coupon, with **X** marked before the position for which you wish to be trained? A full explanation will follow.

Do It Now

SPIRAL GROOVED DISCS

GARDNER GRINDER

SPIRAL EMERY CIRCLES

It's one continual grind!

FROM THE TIME the castings leave the foundry until they are boxed and ready for shipment, grinding enters into nearly every step of their manufacture. They are cleaned by grinding, fitted by grinding and finished by grinding. Not only this but the very machines which do grinding for others are themselves cleaned, fitted and finished by grinding.

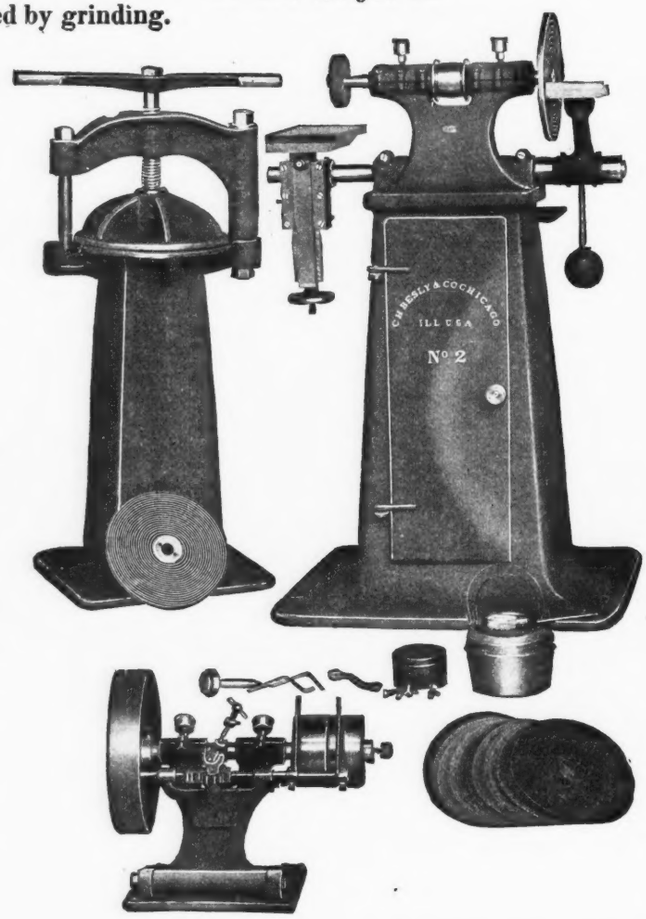
THERE WAS A TIME when "The sound of the grinding was low because the grinders were few," but now it is the most universal process in the shop.

HAVE YOU SEEN the Gardner Grinder with spiral grooves the one with steel discs which never wear out, which never warp and are never out of balance?

THE DISC has a spiral groove cut into the solid metal into which is forced a sheet of emery cloth covered with glue, thus forming a spiral cutting edge. The composition on this emery cloth can be varied so as to adapt it to any class of work and further than this it can be duplicated exactly which emery wheel makers usually can not do. Thus the greatest degree of efficiency may be maintained.

SEND US SOME SAMPLES of your work and we will test them free of charge and tell you exactly what our grinder can do.

If we cannot save you something we will tell you so.



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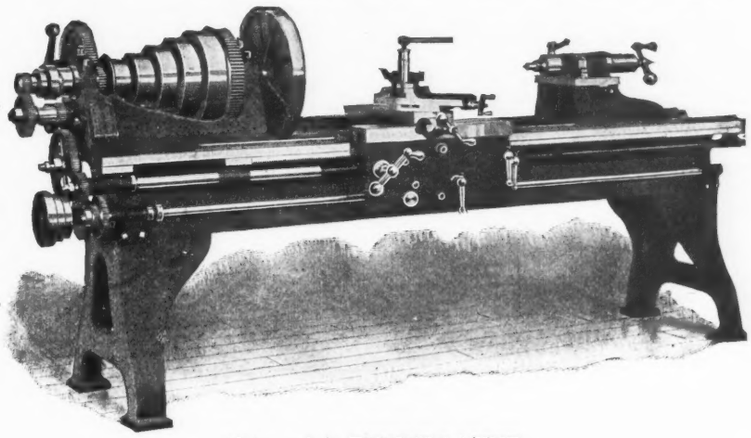
Walcott Lathes.

15 in., 18 in., 22 in., and 32 in. Swing.

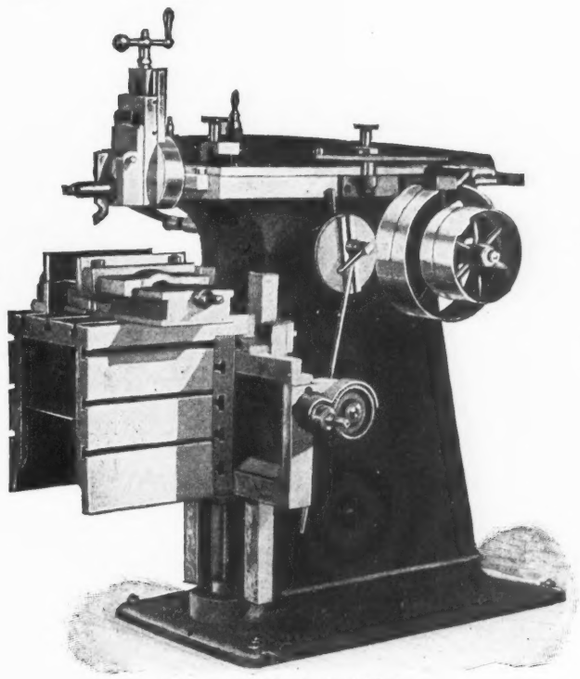


18 in. x 8 ft. ENGINE LATHE.

Shaping Machines.

Geared Shapers,

15 in., 22 in., 26 in., 30 in., 34 in., and 48 in.



22 in. GEARED SHAPER.

Crank Shapers,

14 in., 16 in., and 18 in.

Our Machine Tools are of the latest improved design, well built in every particular and fully adapted to the work for which they are intended. Send for catalogue.

Geo. D. Walcott & Son, Jackson, Mich., U. S. A.

Our Tools can be seen at the establishments of

Buck & Hickman, London, England.
Strong, Carlisle & Hammond Co., Cleveland, O.
Fenwick Freres & Co., Paris, France.
Montgomery & Co., 105 Fulton St., N. Y. City.
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30 Points and Advantages of The "Ideal" Engine Lathe

16 Inch Swing

QUICKEST CHANGE GEAR DEVICE, (PATENTED). Changes made in 7 seconds. Simplest index plate. Only 5 change gears running in thread cutting. Disc covers all change gears. Plain heavy spur gears only. Each gear independent. Cuts threads from 2 to 56 per inch. Feeds turning from 8 to 224 per inch. All changes of threads or feeds made while lathe is in motion. FRICTION GEARED HEAD SPINDLE. Spindle revolves in self-oiling boxes. Reversing mechanism in head, R. M. controlled by operator at apron. Automatic stop in both directions. Taper attachment furnished when desired. *All* gears ***solidly*** covered by guards. Friction countershaft with self-oiling boxes. Cutaway or recess tail stock. Patent spring top oilers. Special heavy steady rest and follower. Unusual heavy weight, (2300 lbs.—16 inches by 6 feet.) Accessibility of *all* parts. Large hole through spindle. All cylindrical parts ground. All flat bearing surfaces scraped. Compactness and neatness of design. Rigidity and accuracy under heavy strain. A perfect tool room lathe. An economical manufacturing lathe.

Write us for special prices and terms on our Tools worth having on file.

N. B. 14 Inch and 18 Inch in process—Ready 60 days

The Springfield Machine Tool Co.

Springfield, Ohio

U. S. A.

Agents...

The Garvin Machine Co., New York and Philadelphia. Chandler & Farquhar, Boston. The C. H. Wood Co., Syracuse, N. Y. California Hydraulic Eng. and Sup. Co., San Francisco, Cal. The Fairbanks Co., Buffalo, N. Y. McDowell, Stocker & Co., Chicago. The E. A. Kinsey Co., Cincinnati. The Somers, Fitler & Clarke Co., Pittsburg.

Milwaukee Milling Machines

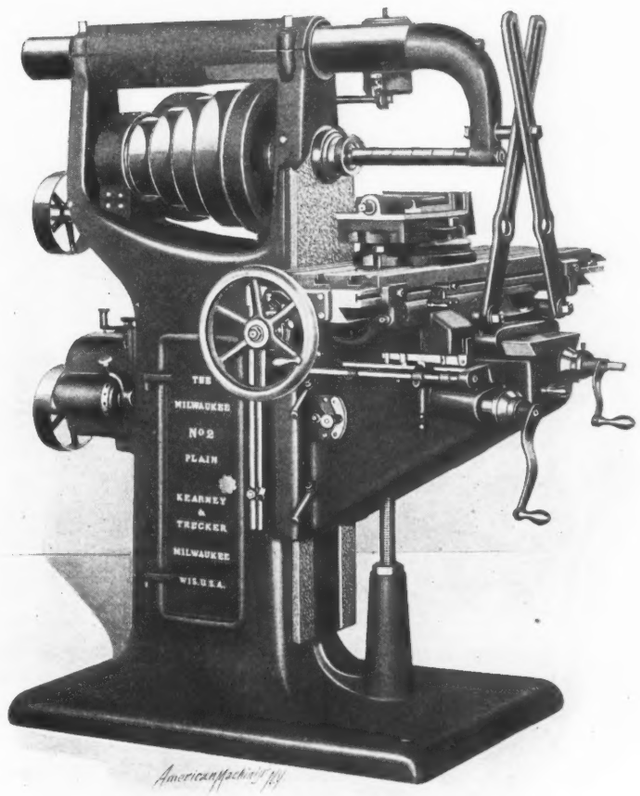
Are Unrivaled in Efficiency

They will do more and better work than any other milling machine.

Do it easily, accurately and economically, too.

They are noted for their superiority of design and construction.

All millers are fitted with box section knee, the strongest form in which metal can be distributed, and being closed on top, all dirt is effectually excluded.



The changes of feed are readily obtained by means of the feed change box at the rear of the machine. The feed mechanism is proportioned to take care of the heaviest cuts that the main belt will pull (And there is no machine that will do heavier work for its size than the "Milwaukee.")

All automatic feeds are controlled by a lever at the **front** of the machine, and only one can be engaged at a time. This cut shows the No. 2 Plain Machine with all automatic feeds, an exceptionally good machine for manufacturing purposes.

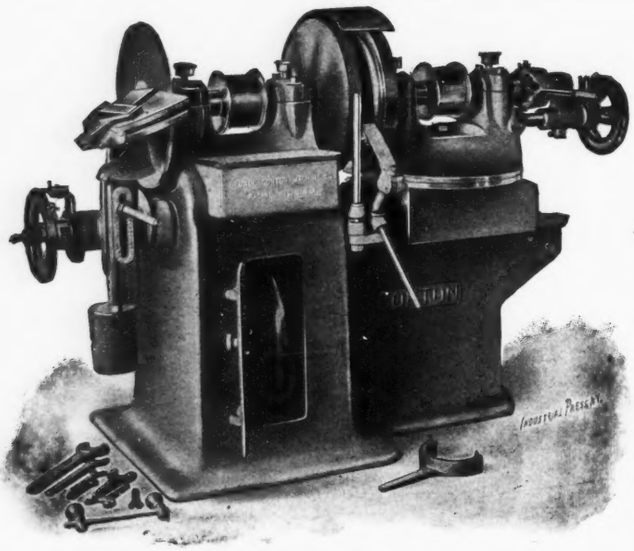
BUILT BY KEARNEY & TRECKER, AT MILWAUKEE, WIS., AND SOLD ONLY BY

Hill, Clarke & Company

14 South Canal St. Chicago — **Machinery Merchants** — Main Office, 156 Oliver St., Boston — 123 Liberty St. New York

PITTSBURG REPRESENTATIVE, CHAS. G. SMITH CO., 347 FIFTH AVENUE

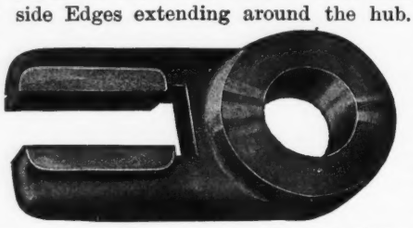
USE A GORTON DISC GRINDER... FOR FLAT SURFACES



No. 15 Disc Universal Flat Surface Grinder.

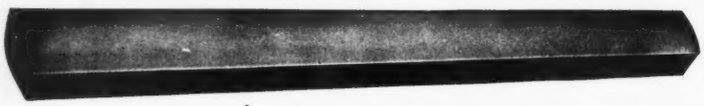
Insures accuracy, and does the work in a fraction of the time it could be finished in any other way.

This cut shows a Cold Pressed Hexagon Nut. Short diameter 2 inches. Roughed and finished accurately in three minutes on our No. 6 Disc Universal Grinder. Time required by New No. 15 Machine, one and one-half minutes.



Brass Casting 4½ inches long. Finished from the rough on two Inside Slot Faces, on two Outside Slot Faces on the entire Flat or Face Side, and on Outside Edges extending around the hub. Roughed and finished accurately in ten minutes on No. 6 Machine.

Same work done on New Machine in five minutes.



Eight inch Connecting Rod Key, O. H. Steel, finished all over. From 1-100 to 2-100 inch of stock removed on each face. Roughed and finished on No. 4 Disc Universal—time, fifteen minutes. Finished on New No. 15 Machine in about seven and one-half minutes.

Send us samples of your work requiring flat surfaces and we will finish and return them free of charge, giving time required for the work.

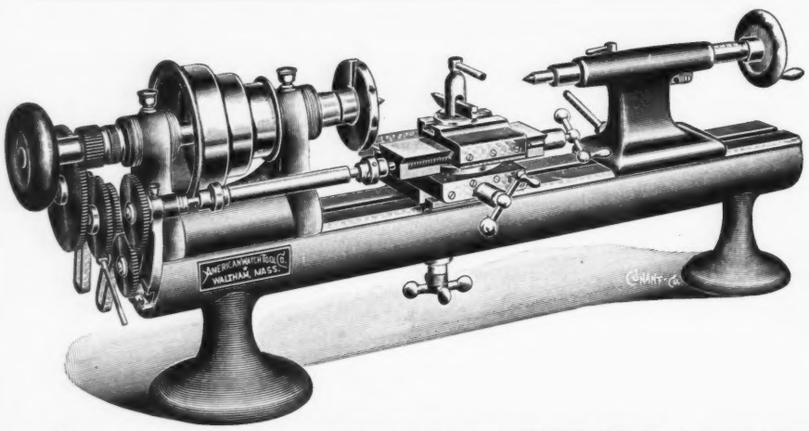
GEO. GORTON MACHINE CO., - RACINE, WIS., U. S. A.

American Watch Tool Company,

Waltham, Mass.

Builders of High Grade Automatic Machinery

This **PRECISION LATHE** cuts both English and metric threads with same screw. **WIRE CHUCKS** are our specialty. Any kind and size.

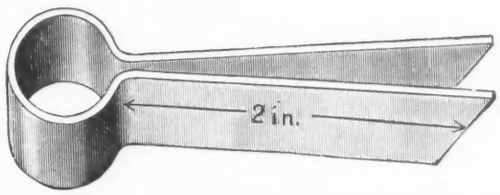


We are the only builders of the celebrated SNYDER CHUCK, designed for both inside and outside holding.

In Our Catalogue No. 114 M

of Bolts, Screws and Factory Supplies

SPRING COTTERS



FLAT SPRING KEYS

There are arranged and illustrated and carefully classified a large showing of items of interest to users of this line. While we are very extensive distributors of Tools, we are also heavy handlers of Bolts, Screws, Nuts and kindred items, and we are particularly anxious to figure with YOU.

The list includes Spring Cotters, Spring Keys, Rivets of various kinds, Thumb Screws, Set Screws, Machine Screws, Cap Screws, Wood and Coach Screws. Common Carriage Bolts, (also Philadelphia) Machine, Tap, Stove, Expansion and Coupling Bolts. Nails, Nuts, Rope, Wire, Chain, Etc., Etc. If you are purchasers of these goods you can not afford to be without this little 95-page Encyclopedic-Catalogue. Write us concerning copies.

Hammacher, Schlemmer & Co., New York City,

SINCE 1848.

A GOOD ADVERTISEMENT

Placed by us recently in the "Monthly Journal I. A. of M." brought us hundreds of letters from working machinists in every part of the United States, Canada and Mexico and the Men Behind The Tools said more good things about Armstrong Tool Holders than we would dare to print. ARMSTRONG TOOLS will SAVE MONEY FOR YOU! IF you doubt our statement go out into your machine shop and ASK YOUR OWN MEN.

WITH THIS

Big, Strong, Drop-Forged Steel Holder, Case-Hardened, with Set Screw of Tool Steel Tempered on the Point and carrying a BIG Cutter of Armstrong Self-Hardening Steel,

Patented Feb. 28, 1893, and patent pending.
Made in 11 sizes each, Straight Shank and Right and Left Hand Offset.

You Can Increase your FEEDS and SPEEDS to your Machine's full Capacity.

WRITE FOR NEW CATALOG.

Beware of Infringements.

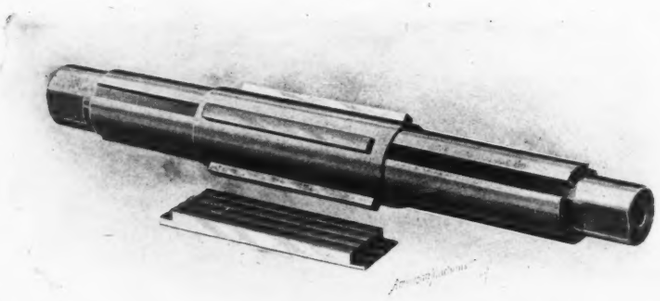
ARMSTRONG BROS. TOOL CO.

"The Tool Holder People." CHICAGO, U. S. A.

FOREIGN AGENTS—Chas. Churchill & Co., Ltd., London, Manchester, Birmingham, Glasgow. Schuchardt & Schutte, Berlin, Brussels, Vienna, St. Petersburg. G. Koeppen & Co., Moscow. C. S. Christensen, Christiania. Aikenhead Hardware, Ltd., Toronto, Canada. Williams & Wilson, Montreal, Canada.

PATENTED
FEB. 16, 1886.
FEB. 28, 1893.
MAR. 12, 1895.
APR. 18, 1898.
NOV. 14, 1899.
JAN. 29, 1901.
MAY 28, 1901.
MAY 27, 1902.
OTHER PATENTS APPLIED FOR.

If You're Not Interested

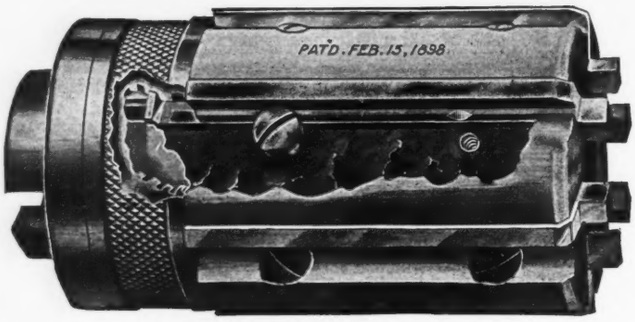


in time saving or money saving you're not interested in Nicholson Expanding Mandrels, because those are their strong points. Nine of the expanding mandrels will do you more good than a hundred of the solid kind; they are always ready too; take anything from one to seven inch holes, hold the work right—all right every way. We'll gladly tell you more about them.

W. H. NICHOLSON & CO., Wilkes-Barre, Pa., U. S. A.

FOREIGN HOUSES:—C. W. Burton, Griffiths & Co., London. Schuchardt & Schutte, Berlin, Cologne, Vienna, Brussels, Stockholm, St. Petersburg. A. Janssens, Paris.

Adjustable Blade and Adjustable Universal REAMERS



Adjustable Universal Reamer.

Efficient, Durable, Economical.

The Adjustable Blade Reamers are intended for use where few changes of size are required and are made with inserted blades which can be underlaid to compensate for wear, thus allowing for many times regrinding. In our Universal style Reamer, rapid and accurate adjustment is secured by turning a knurled ring controlling the underlying wedges. By our patented construction these reamers are made as reliable as a solid reamer Blades are made of the best steel and when used up can be easily and cheaply replaced. Sizes up to 6 inches in diameter furnished out of stock, larger sizes made to order.

Our Improved Expanding Arbors

for Shell Reamers are better than anything else of the kind made.

Expanding Arbor.

We also manufacture a line of Milling Cutters with inserted blades, straight or spiral, adjustable for **width** of face as well as diameter. These cutters are especially adapted for large size **Gang Mills,** owing to the ease with which sizes can be maintained. Illustrated circulars and price list mailed on request.

Ott. Mergenthaler Co., Incorporated, Baltimore, Md.

We do Gear Cutting, Cam Cutting, and build Special Tools and Machinery.

ROGERS

SOLID ADJUSTABLE REAMERS

FOUR STYLES AND ALL SIZES CARRIED IN STOCK.

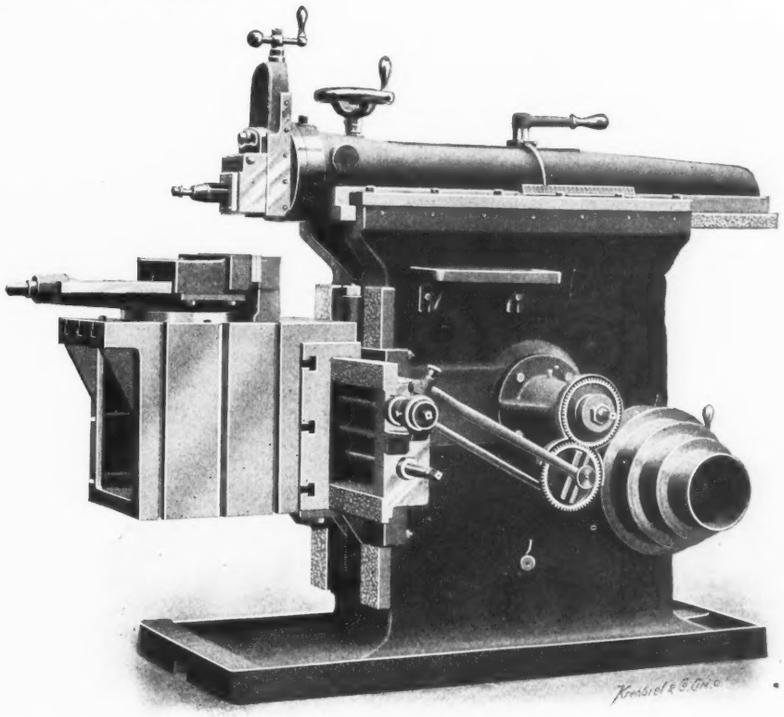
WRITE FOR NO. 6 TOOL CATALOG.

THE JOHN M. ROGERS, BOAT, GAUGE AND DRILL WORKS,

GLOUCESTER CITY, NEW JERSEY, U. S. A.

FOREIGN AGENTS: Chas. Churchill & Co., London and Birmingham. C. W. Burton, Griffiths & Co., London. Selig, Sonnenthal & Co., London. V. Lowener, Copenhagen, Denmark.

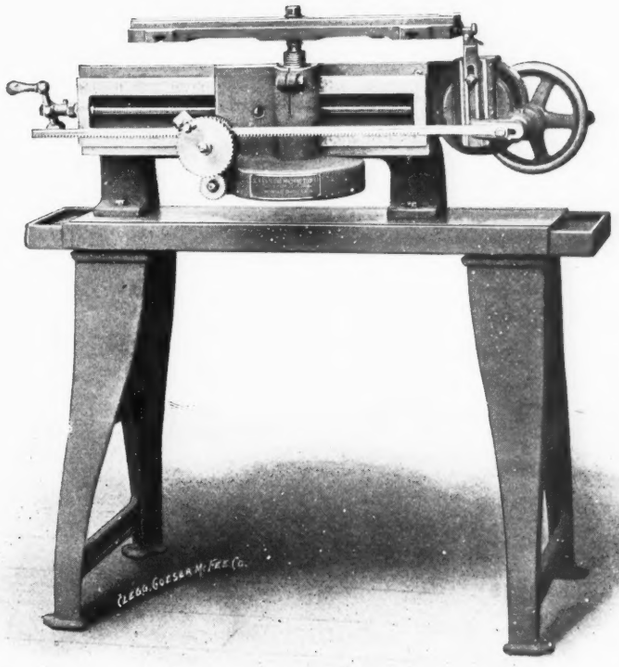
Pillar Shapers
Traverse Shapers



24 Inch Back Geared Crank Shaper

The **Cincinnati Shaper Co.**
Cincinnati, Ohio, U. S. A.

NEW GRADUATING MACHINE.



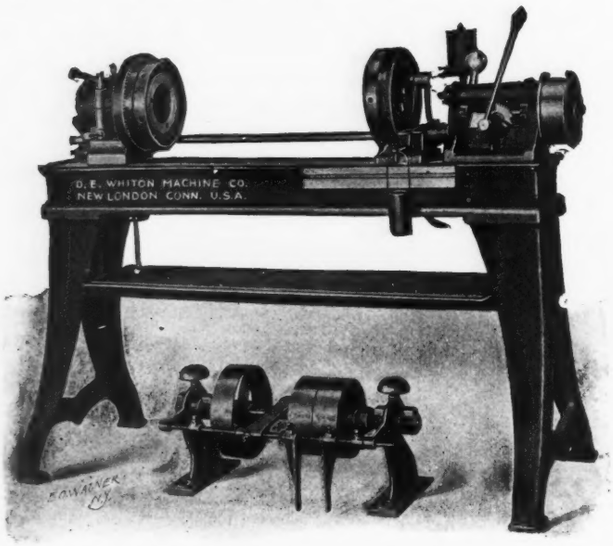
The above machine is designed for graduating all cylindrical parts. It will take work from the vertical to the horizontal, and the graduating head swings through an angle of 90 degrees, This machine will produce ten times as much work as an automatic gear cutter or milling machine, besides regulating the lengths of lines, insuring accuracy and no spoiled work.

For further information apply to

The R. K. LeBlond Machine Tool Co., 4609 to 4621 Eastern Ave., CINCINNATI, O., U. S. A.

J. Lambercier & Co., Geneva, Sole Agents for Switzerland.

THE WHITON REVOLVING CENTERING MACHINE



is designed to accurately center previously finished shafts four inches in diameter and smaller.

The work is held in two centering chucks, one of which revolves and acts as a driver. The shaft is firmly gripped in the revolving chuck, while the end near the tool is supported and revolved in the jaws of the stationary chuck as in a lathe center rest. The centers may then be drilled and reamed to the required depth by the drilling and reaming tools which revolve in a direction opposite to the work and at different speeds. It is only in this manner that finished shafting can be centered to run perfectly true.

This new machine has all the advantages of our regular machines and the revolving attachment in addition. It has the same spindle mechanism, headstock and three-jaw centering chuck used in our Two-Spindle Centering Machine. Traverse of the spindles is limited by suitable stops; positive locking device for head prevents either spindle being advanced except when on center, and when advanced no lateral movement of the head can occur.

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D. E. WHITON MACHINE COMPANY, New London, Conn., U. S. A.

Nine-Tenths of the Cost Saved

By using our **48 Inch Automatic Worm Wheel Hobbing Machine.**

This machine is designed to cut Worm Wheels from 6 in. to 48 in. in diameter, any pitch. Wheels may be cut either from the solid or dressed out with the hob from cast teeth. Right or left hand wheels cut with equal facility. A rigid, well built tool possessing ample driving power and accomplishing the work at one tenth the cost of ordinary methods. Descriptive circular.

THE GRANT TOOL CO., - Franklin, Pa., U. S. A.

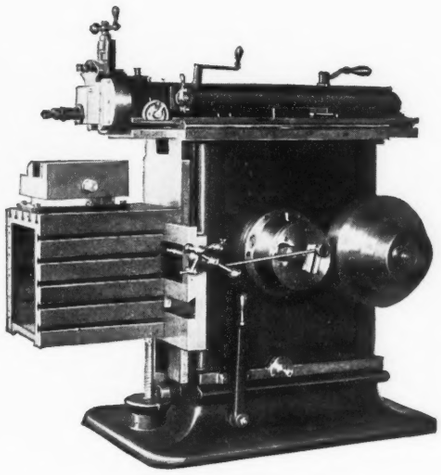
New York Office, 114-116-118 Liberty Street.

Accurate, Reliable, Convenient, Heavy, Powerful.

These are a few of the features in connection with

POTTER & JOHNSTON UNIVERSAL SHAPERS

Two Sizes—15 and 24 Inch Stroke.



24 Inch Size.
Net Weight, 4000 pounds.

Automatic power down feed,

Ten changes of down feed,

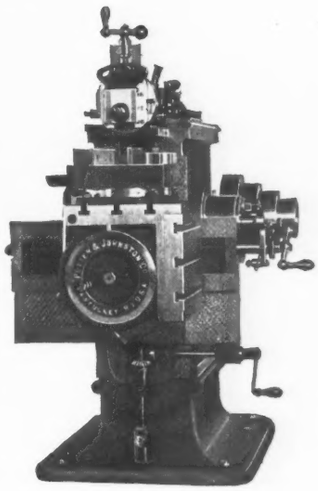
Automatic feed stop,

Swivelling table revolved through worm and worm gear rotary adjustment.

Tilting side fitted to swivel table when specified.

Table on 24 inch machine **raised and lowered by power.**

Particularly well adapted for **tool room service.**



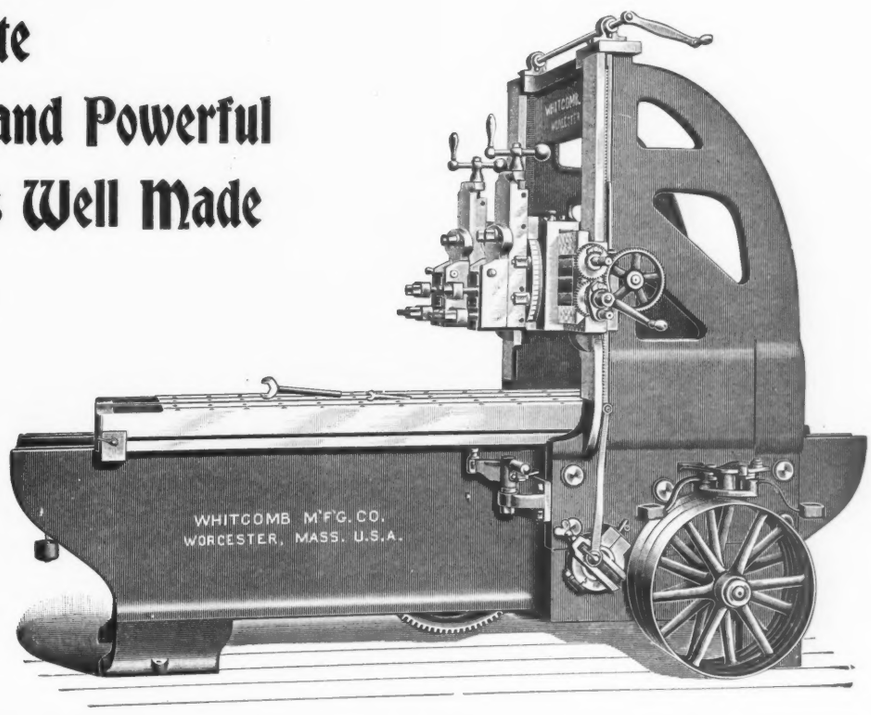
15 Inch Size.
Net Weight, 2300 pounds.

Potter & Johnston Machine Company,
Pawtucket, R. I., U. S. A.
New York Office, 126 Liberty Street, Walter H. Foster, Manager.

Whitcomb Planers

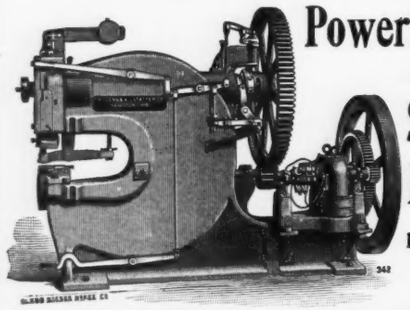
17 in. x 17 in. to 48 in. x 48. in.

Accurate
Heavy and Powerful
Always Well Made
Handy



Whitcomb Manufacturing Company

Worcester, Mass. U. S. A.



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Belt, Steam and Electrically driven.

LONG & ALLSTATTER CO.

HAMILTON, OHIO, U. S. A.

Our machines are made in over 350 sizes and varieties.

SINGLE,
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FOR
Railroad Shops,
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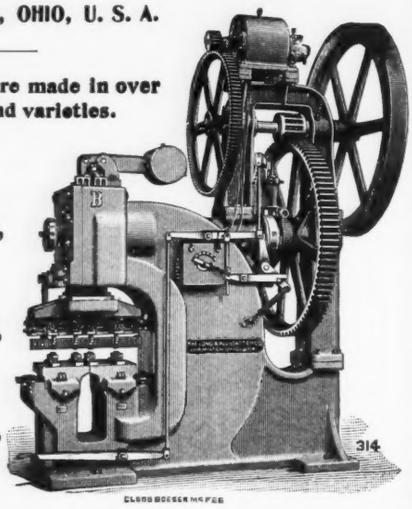

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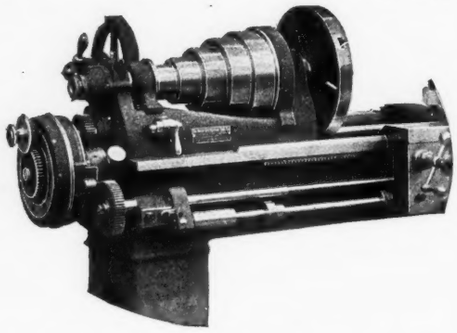
In Feeding and Screw Cutting.



Our System of Gearing

provides a complete range of positive geared feeds and takes the place of independent change gears and feed cones. The quickest and simplest of all quick methods of making changes Can be applied to any lathe you may have in use, and new lathes of any make are equipped with this attachment if so specified.

Sold on thirty days' trial and fully guaranteed.

For sale by all dealers.

The National Machine Tool Co.

Cincinnati, Ohio, U. S. A.

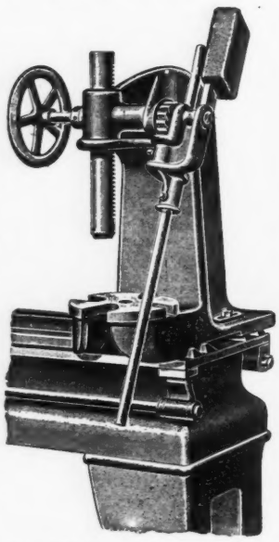
Our Friends Bear Witness.

"We have found your Arbor Presses to be very convenient, and now that we have used them for several years, we do not see how we could manage to get along without them."

POTTER & JOHNSTON MACHINE CO.
Pawtucket, R. I.

"We are very well satisfied with the Arbor Presses we have had."

GISHOLT MACHINE CO.
Madison, Wis.



No. 3½ Press on Lathe.

Edwin E. Bartlett,

368 Atlantic Ave., Boston, U. S. A.

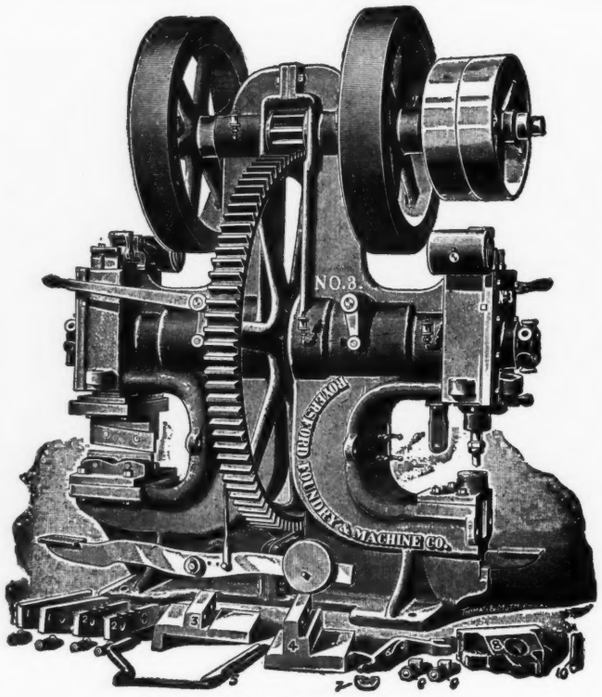
Manufacturer of

Greenerd Arbor Presses.

PUNCH AND SHEARS

COMBINED AND SINGLE.

Up-to-date Tools. **Built to give Satisfaction.**



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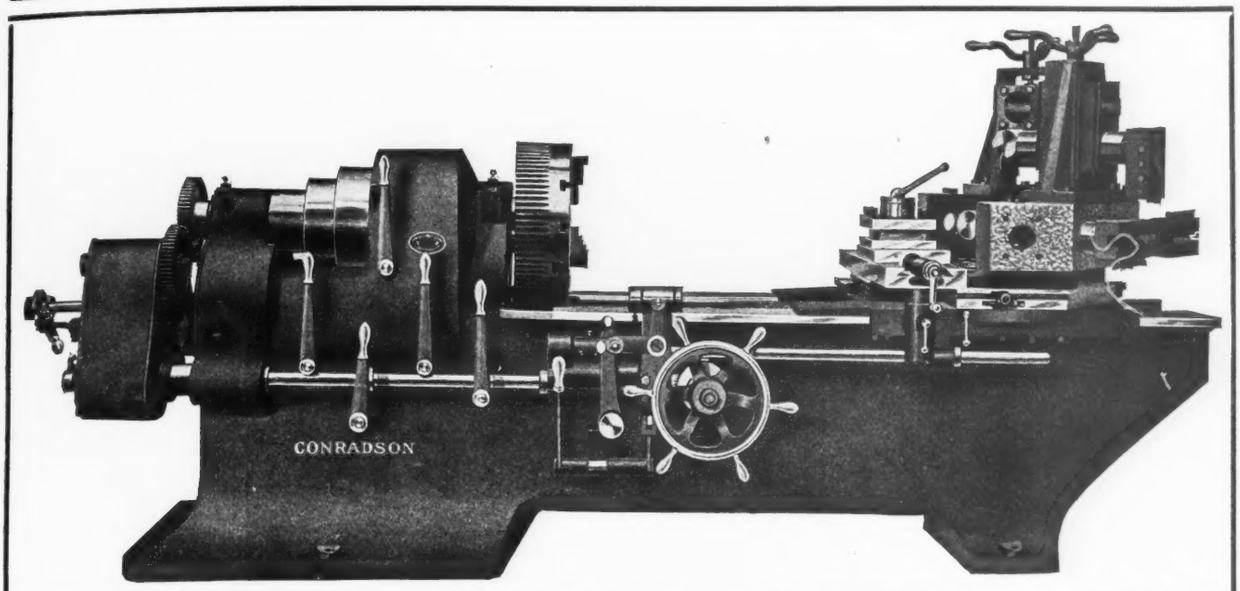
Royersford, Pa., U. S. A.



24-IN. SEMI-AUTOMATIC TURRET LATHE

—BUILT BY—

AMERICAN TURRET LATHE MFG. CO.

SALES OFFICE, WARREN, PA.

FACTORIES, WARREN, PA., AND WILMINGTON, DEL.

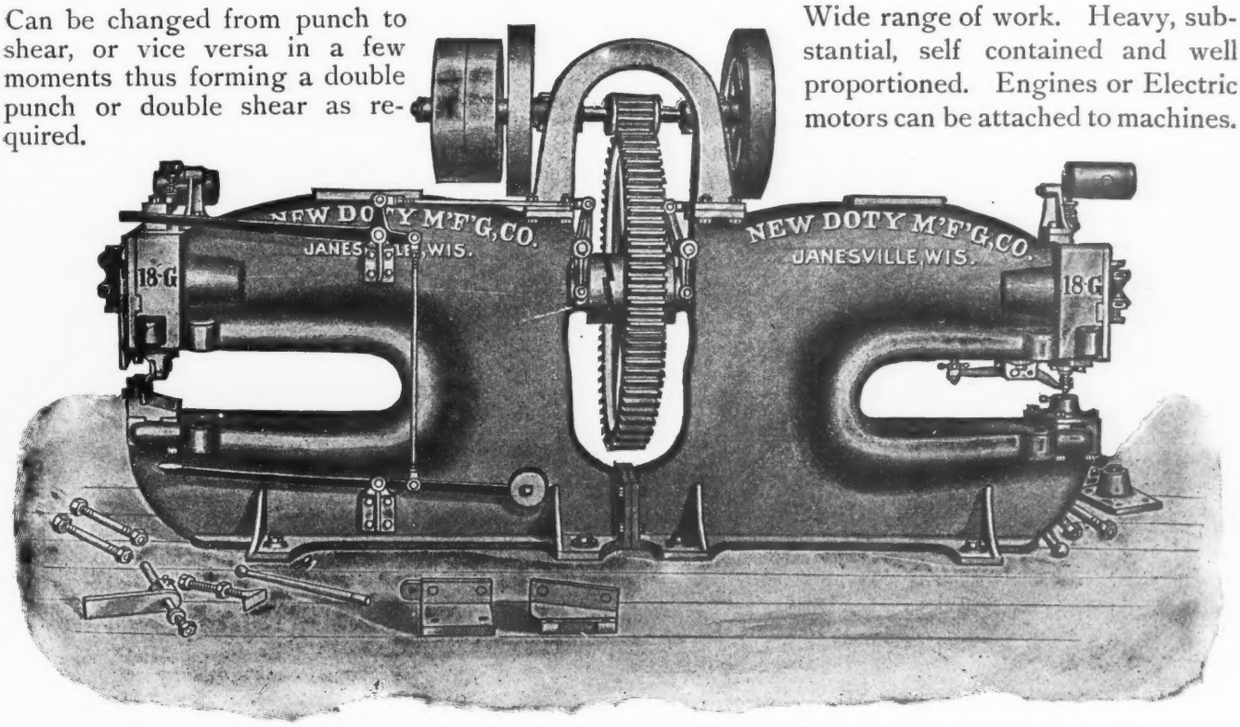
We build several sizes and styles of turret lathes. It will pay you to investigate the merits of our machines. We solicit your inquiries.

ENGLISH AGENTS: CHAS CHURCHILL & CO., LTD., LONDON.

COMBINED PUNCH AND SHEAR

Can be changed from punch to shear, or vice versa in a few moments thus forming a double punch or double shear as required.

Wide range of work. Heavy, substantial, self contained and well proportioned. Engines or Electric motors can be attached to machines.



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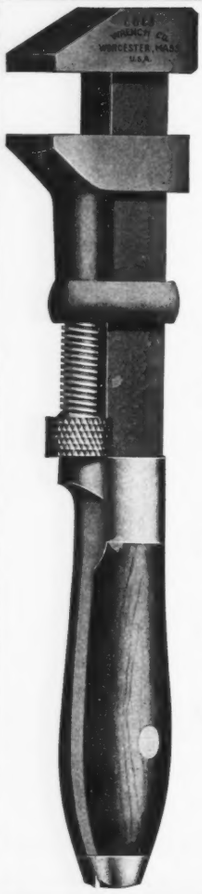
New Doty Mfg. Company,

150 North Main Street, Janesville, Wisconsin.



A

TRADE-MARK.

"KNIFE-HANDLE"

REG'ST'D APR. 9, 1895.

WRENCH

Has a handle which is mechanically secured at both ends, as well as by the rivet.

Imitations depend on rivet only to secure wood.

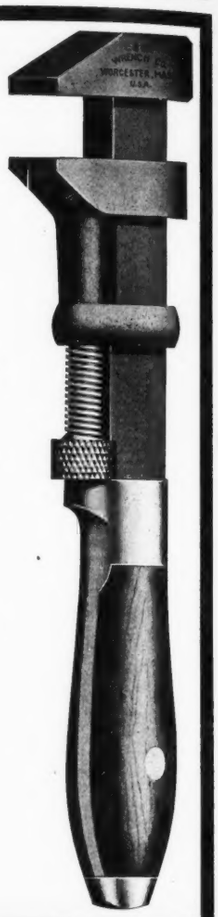
Other differences exist, which are just as important.

The Coes excels in all minor points, and is DURABLE. Made for use.

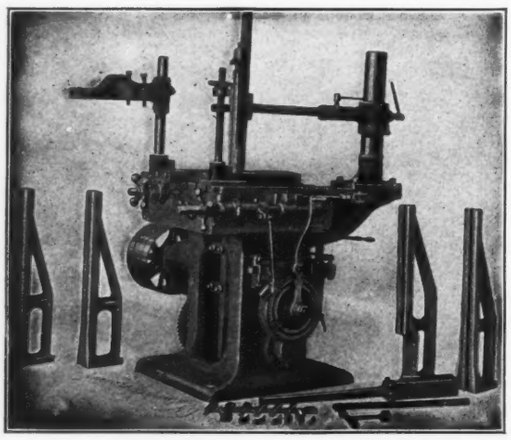
COES WRENCH COMPANY,

WORCESTER, MASSACHUSETTS.

AGENTS:—J. C. McCarty & Co., 10 Warren St., New York.
John H. Graham & Co., 113 Chambers St, New York.,
Holborn, London, E. C. 38 Vestergade, Copenhagen, K.



Morton Standard Key-way Cutter.



It's our Standard Key-way Cutter and it's best. It is accurate and will wear as long as any other first-class machine tool. It is the most rigid key-way cutter, the quickest to set and easiest to operate. It will cut key-ways accurately in crank discs, locomotive drivers, propeller wheels and similar work by removing extension guide or bearing, because its appliances are suited to all sorts of work. It can be set, before the work is put on the machine, to cut a key-way of a given width, depth and taper. It is heavily back geared and requires less power than any other. You never need pull or push a lever or turn a feed screw. Just turn a little button and the machine feeds automatically, relieves automatically on return stroke, and feed stops automatically when to depth. The cuts at the right and left show the key and how it is drawn with a lever.

Our list tells you our standard sizes, but we will make keys to your specifications and guarantee entire satisfaction, gauging to one thousandth of an inch if desired.

We can furnish you with the most modern and accurate Stationary and Portable Key-seating Machines, and with accurate finished keys, practically ready to drive, at a saving of 50 per cent. over ordinary methods.

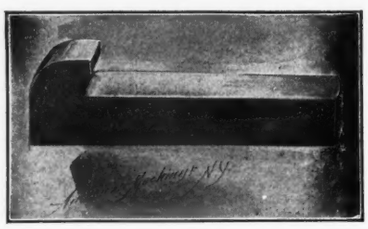
We also manufacture Portable Planers and Draw Cut Shapers, both Traveling Head and Pillar of the heaviest type.

For further particulars address

MORTON MANUFACTURING COMPANY,

Muskegon Heights,

Michigan, U. S. A.



Walter H. Foster, 126 Liberty St., New York, N. Y., and Section 2, the Bourse, Philadelphia, Pa.

The Binsse Machine Is No Quitter...

Give to the old style machine heavy cuts and strong feeds at the high speeds of to-day's steels, and you will observe it slow down and quit. Our machine is no quitter, for it has three times the power of the back geared style.

The old kind was not designed for the wrenching strains of to-day's practice; it was drawn when these forces were unthought of and they find it to be limber. It curls up if you try to force it towards a big output.

The Binsse Machine exists for just that kind of work, and it goes along under a heavy load as easily and as sweetly as a light one.

More Work and Better.

Remember that, please, and there are facts a plenty to make it clear to you.

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The Binsse Machine Company
Newark, N. J.

MITTS & MERRILL

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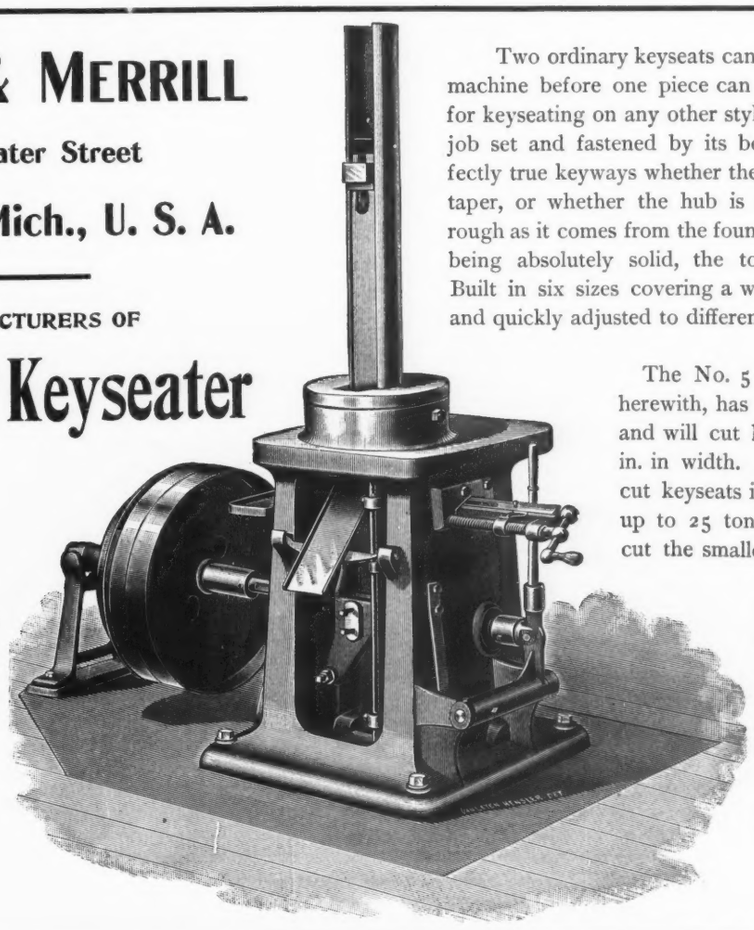
MANUFACTURERS OF

The Giant Keyseater



Two ordinary keyseats can be finished on this machine before one piece can be fastened ready for keyseating on any other style machine. Every job set and fastened by its bore. Will cut perfectly true keyways whether the hole is straight or taper, or whether the hub is faced true or left rough as it comes from the foundry. The support being absolutely solid, the tool cannot spring. Built in six sizes covering a wide range of work and quickly adjusted to different requirements.

The No. 5 Keyseater, shown herewith, has a stroke of 25 in. and will cut keyseats up to 3½ in. in width. It is designed to cut keyseats in wheels weighing up to 25 tons or more, but will cut the smallest keyseat just as well and as quickly as a smaller machine.

More than 300 of these machines used by the leading shops of America and Europe.

FOREIGN AGENTS:
C. W. Burton, Griffiths & Co., London, Eng.
Gustav Diechmann & Sohn, Berlin, Germany.
Penrhyn Neville, Milan, Italy.

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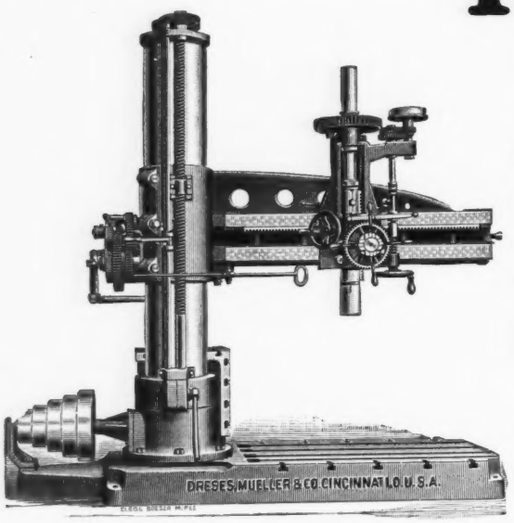
We make a specialty of

Radial Drills.



BUILT IN ALL USUAL STYLES AND SIZES.
All have Tapping Attachment in the Construction.

As Pioneers in the development of these tools we have gained an international reputation, and we are still ahead. Ask the users what they think of them.

Dreses Machine Tool Co.

Cincinnati, Ohio, U. S. A.

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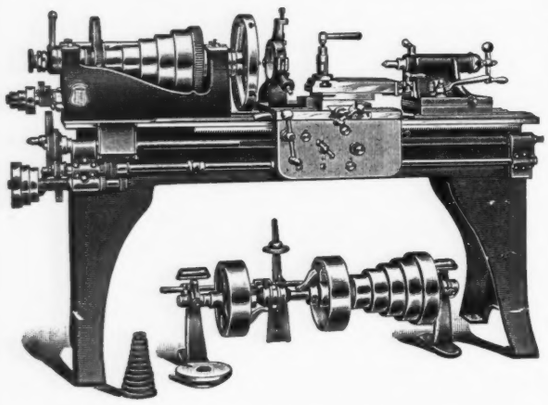
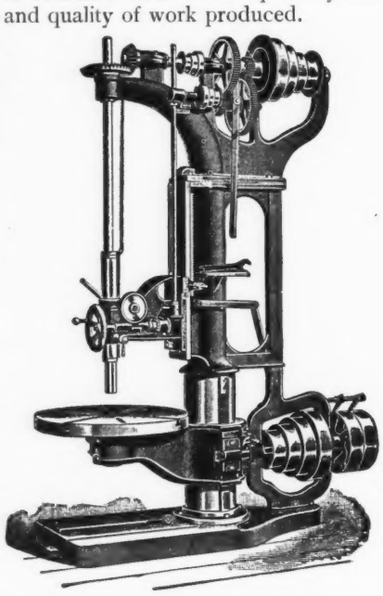
Blaisdell's Name on a Machine



Is a synonym for value. We have been in the business a good many years and can guarantee our tools to stand up to their work every day and all day. They are accurate, durable, simple in construction and will equal any tool on the market in quantity and quality of work produced.



Our Lathes and Drills are good all around tools for every-day purposes, and for special work we build special heavy engine lathes. Lathes have six changes of belt feed; gear feed, screw feed. Built with plain, compound, raise and fall or English compound rest. Heavy, powerfully geared, large cones and wide belts. All tools carefully tested before leaving the works.

We build the following sizes:

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13 inch to
36 inch swing.

Drills,
20 inch to
50 inch.

Pattern Makers' Lathes a specialty.

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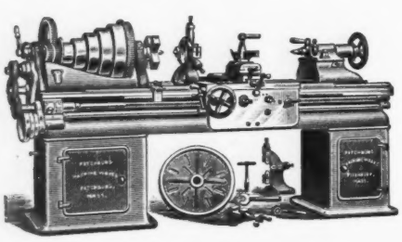
FOREIGN AGENTS: C. W. Burton, Griffiths & Co., London, Eng. Henry W. Peabody & Co., France and Austria. V. Lowener, Copenhagen, Denmark. Wilh. Sonneson & Co., Malmo, Sweden. Deutsche Garvin Maschinen Fabrik, Burg Strasse 17, Berlin, Germany.



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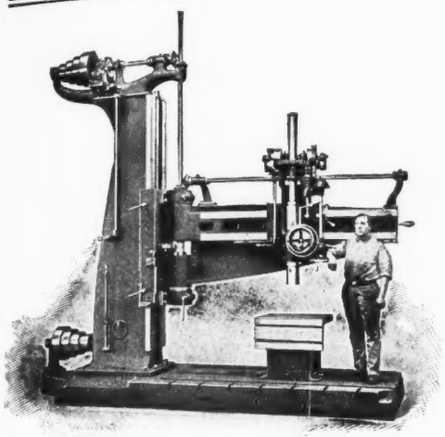
Fitchburg tools are up-to-date in pattern; perfectly finished; strong, well fitted and stiff. Every machine carefully tested before leaving the factory.

Lathes, Shapers, Planers, Horizontal Boring Machines, Drilling Machines.

Fitchburg Machine Works, Fitchburg, Mass., U.S.A.



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Plain Radial Drills

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☞All bevels and mitres planed from solid.
☞No counter-shaft or wrenches required.
☞All levers in easy reach of the operator.
☞Patented quick return which engages feed instantly.

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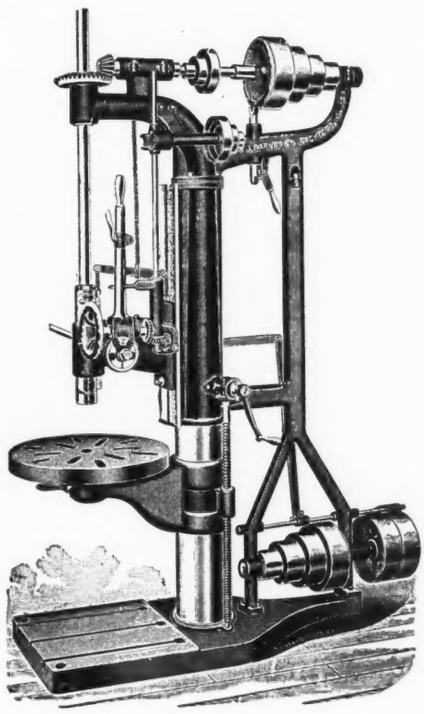
26 Inch Swing Drill



...with Back Gear - Sliding Head
Wheel Feed - Lever Feed
Power Feed

ALL ON THE ONE DRILL

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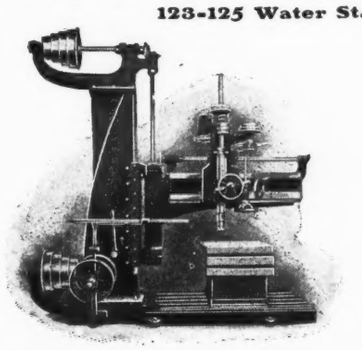

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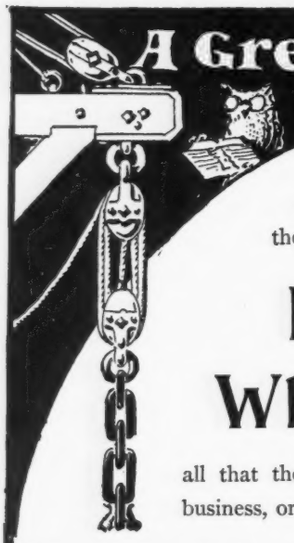

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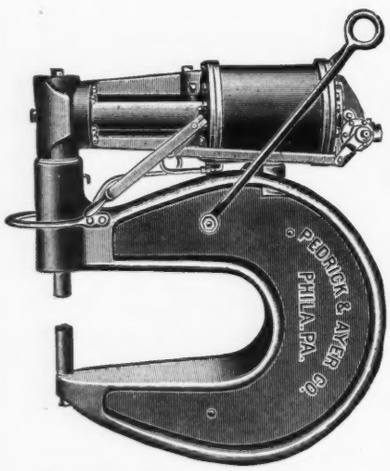

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comprises several styles and sizes and is adapted for any kind of work. These Riveters secure the maximum pressure on a rivet with as little weight in the machine as is possible. They work rapidly, without a jar or shock and give a uniform pressure upon the rivet.

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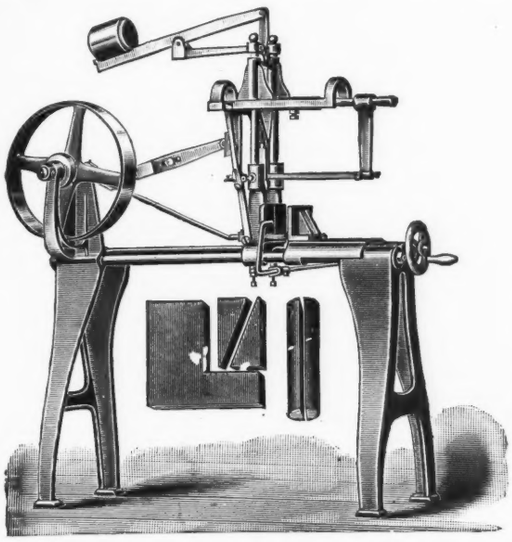

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	6	7	8	9	10	11	12 inch.

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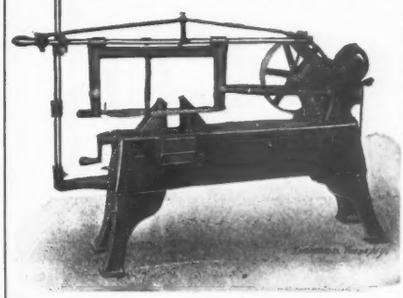

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No. 2, Capacity 10 in. x 10 in.

Draw Cut, Geared Drive.
Combination Feed, with automatic throw-out.
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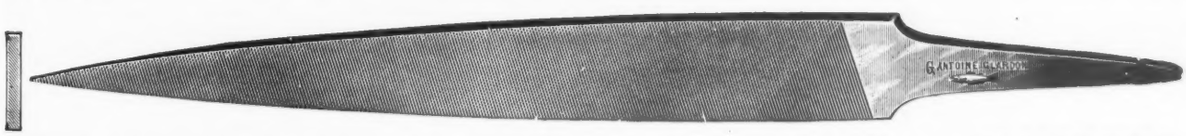

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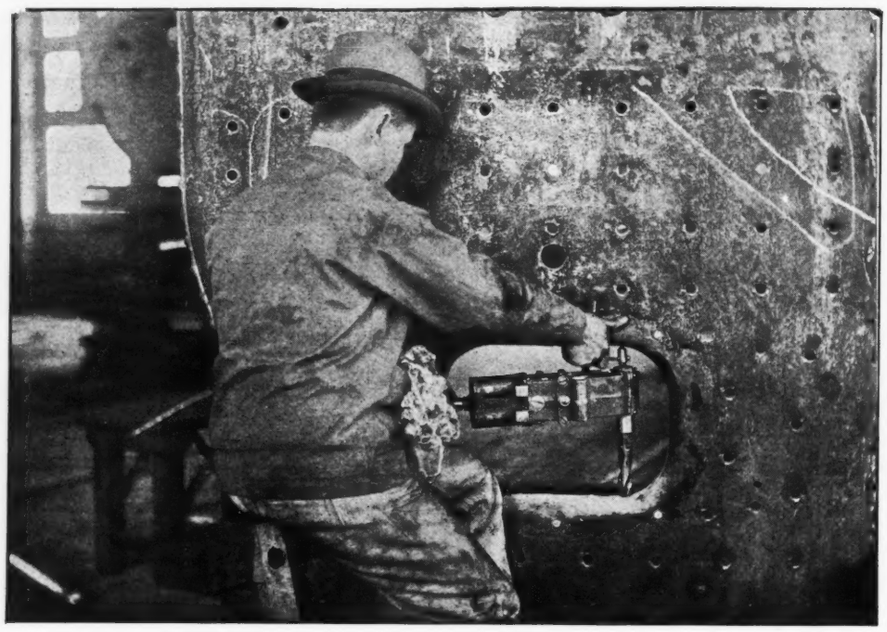

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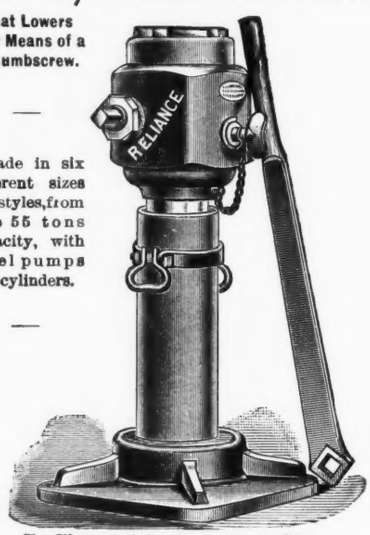

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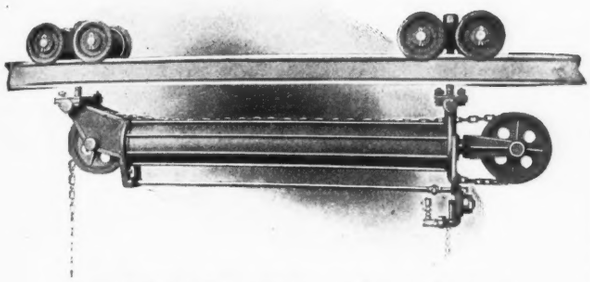

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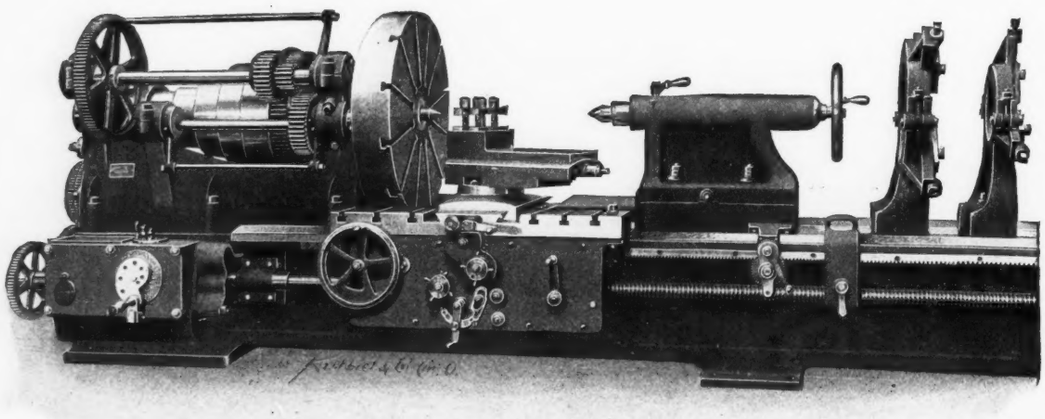

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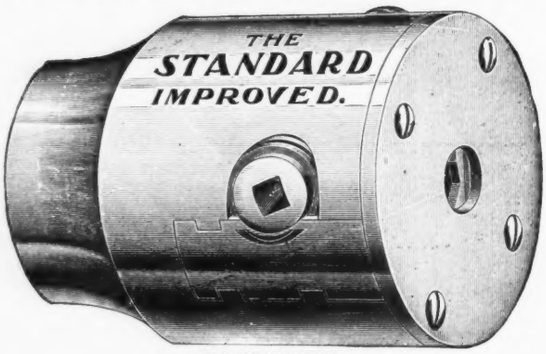

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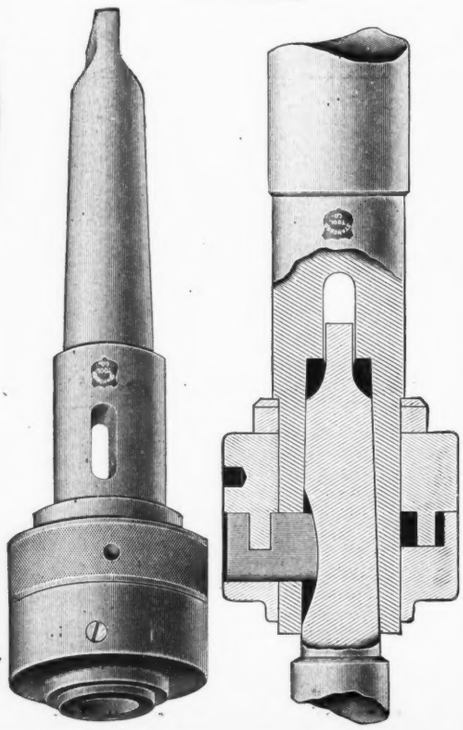

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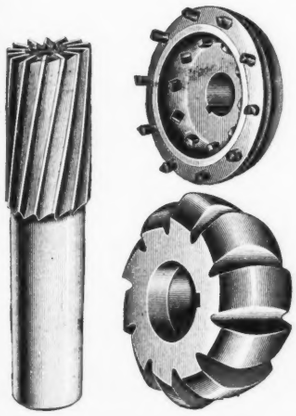

For thirty years we have been manufacturing Milling Machines and fitting them out with Cutters of our own make. This experience has placed us in a position to extend and promote the best practice in the manufacture of Milling Cutters. We have recently greatly enlarged our facilities in this line, and the endless variety which we have been called upon to make furnishes an invaluable experience to draw from. If a reduction in shop cost is sought on any particular job, send us a sketch of the work you require accomplished, and we will submit plan for cutters. A full line of standard sizes is carried in stock.

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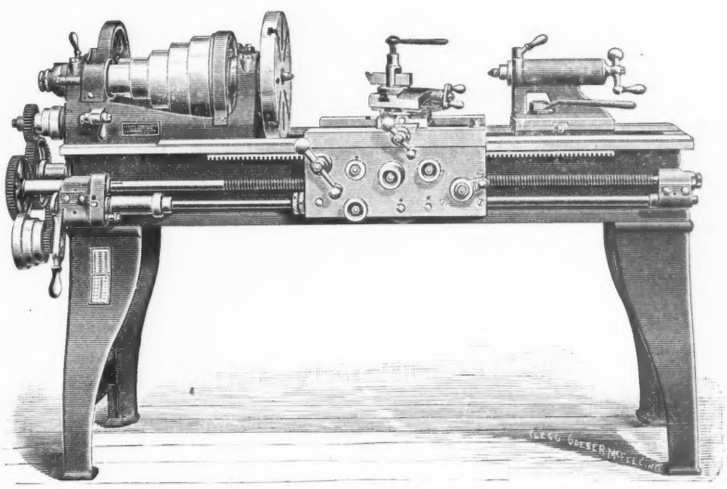
HYDE PARK MASSACHUSETTS U S A

For Tool Room or Factory Purposes

These 14-inch, 16-inch and 18-inch Bradford Lathes are not excelled, if equaled, for this work.

The 14-inch Lathe, here shown, is one of our latest type, modern and practical. Spindle Journals run in hard Bronze Boxes of the taper pattern, mounted for quick and accurate adjustment, so that perfect alignment can be maintained at all times. The change gears have wide face for transmitting more and better power to the feed and screw. They are machine cut and guaranteed to stand up under all strains.



Other features explained in Catalogue C.

Bradford Machine Tool Co., Cincinnati, O., U.S.A.

Engine Lathes, 14 to 36 Inch.

Machine Manufacturers can save time and money by using our

Welding Process.

Illustrations show the kind of work we can do.

Does this not appeal to you as a money saver?

THE
STANDARD WELDING COMPANY,

CLEVELAND, OHIO.

Before Cling-Surface was used this belt had to be run tight under the idler.

Cling-Surface stopped the slipping so perfectly that the idler was not only needless but the belt runs very slack and was doing 55 H. P. as the photograph was taken.

Centers are 10 feet.

Cling-Surface and Easy Belts.

No belt need be run tight. It can at least run easy if not slack when Cling-Surface stops the slipping.

Cling-Surface stopped slipping on this belt. There is now no strain on belt, bearings or shafting. Almost ¾ of driving pulley is hugged by belt—which means power.

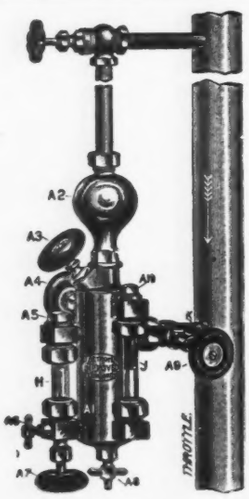
The days of tight belts are over, and Cling-Surface is the means.

It doesn't act like a belt-dressing; it's a filler and penetrates, leaving no sticky surface, and it preserves the belt.

Order and test. Pay if O. K. If not don't pay. You can't very well lose, as we pay all freight if not satisfactory.

Start now.

CLING-SURFACE MFG. CO.,
153-159 Virginia Street, Buffalo, N. Y.
New York, Chicago, Boston, St. Louis, Philadelphia, Toronto, New Orleans.



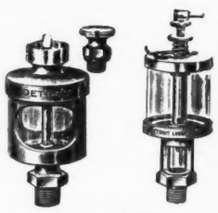
After 21 Years' Service.

"A party here who has used one of your make of lubricators for 21 years now needs some repairs for it." So write Messrs. Boyer & Locka, Machinery Dealers, De Graaf, O., under date of Jan. 2, 1902.

Everything about our lubricators contributes to make them long-lived and durable. They are made extra strong and heavy, only the very best material is used in them, and their design is so compact and harmonious that all strains are evenly distributed. The great majority of the 600,000 sight feed lubricators we have manufactured during the past 22 years are still in use, and we frequently receive small orders for repairs for lubricators 18 to 21 years old. Our lubricators cost a little more than some other makes, but they are well worth the extra difference.

We also make a full line of oil pumps, glass oilers, brass oilers, grease cups, multiple oilers, oiling devices, etc. Our catalogue showing our full line will be sent on application.

Detroit Lubricator Co.
Detroit, Michigan.

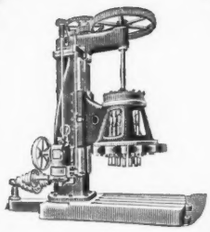


GLASS OILERS.

GLASS BODY OIL PUMPS.

REAMERS ETNA MFG. CO., 43 John St., New York.

THE SCHWERDTLE STAMP CO.,
STENCILS-BURNING BRANDS
STEEL STAMPS & DIES
SEALS-MACH. PLATES-CHECKS
BRIDGEPORT, CONN.

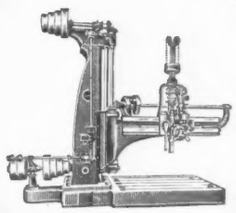


Here They Are.

Four specialties that any manufacturer might well be proud of, and any machine shop proud to own.

One is our **Multiple Spindle Drill** made in various sizes from 4 to 24 spindles—vertical or horizontal—will drill a number of holes simultaneously, in a circle, square, or irregular form with absolute precision.

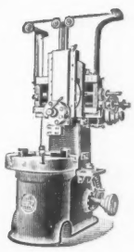
Another is our **Radial Drill.** Either



hand or power feed—countershaft attached. Machine arm supported on patent roller and ball bearings—has tapping attachment.

Then **Our Boring and Turning Mills** built in sizes from 30 in. to 61 in.—have 16 changes of speed—made with one or two heads which are entirely independent in their movement in both directions. These **Mills** are strong, firm, built with special features which insure absolute steadiness of work.

And for making a flexible connection our **Universal Joint,**



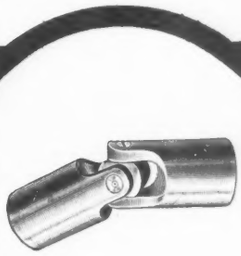
made of bronze or steel, has every advantage; it is strong, light and simple in construction, consisting of five pieces only; absolutely the best joint on the market.

Send for a set of our booklets containing full information regarding the machines we make.

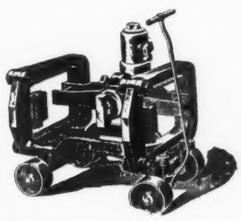
BAUSH MACHINE TOOL CO.

Springfield, Mass.

AGENTS:
Manning, Maxwell & Moore, New York, Chicago, Cleveland, Pittsburg, Boston,
Chas. Churchill & Co., London, Birmingham, Glasgow, Manchester, Newcastle-on-Tyne.
Selig. Sonnenthal & Co., London.
Fenwick Freres & Co., Paris.



Double Piston Outside Pump Hydraulic Jack.



Girder Rail Hydraulic Bender. (Mounted).

Independent Pump Hydraulic Jack.

"Claw" Type Hydraulic Jack.

The

Watson-Stillman Company

204-210 East Forty-third Street
New York, U. S. A.

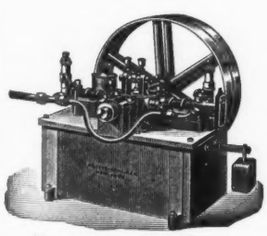
Manufacturers of...

Hydraulic Machinery

Presses, Pumps, Punches,
Shears, Valves, Accumulators,
Benders, Gauges, Fittings.

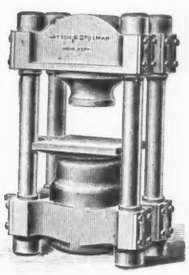
HYDRAULIC JACKS
OF EVERY DESCRIPTION

TUBE EXPANDERS



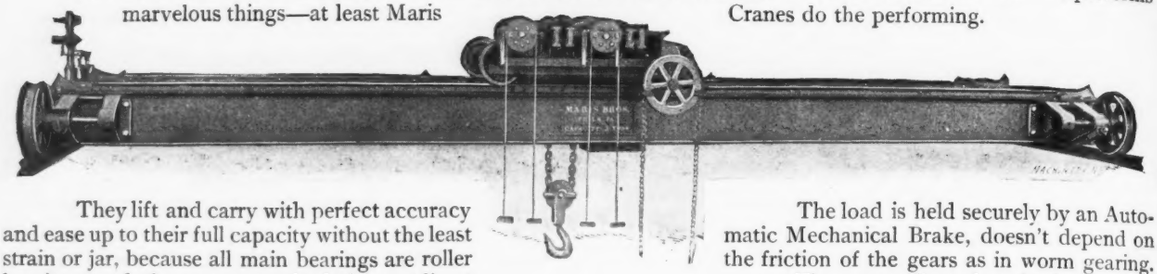
Two Plunger Belt Pump. Automatic Variable.

Universal Hydraulic Beam Punch.



Heavy Hydraulic Die Press.

The touch of the controlling hand to a **MARIS CRANE** is like a wizard's wand. It performs marvelous things—at least Maris Cranes do the performing.



They lift and carry with perfect accuracy and ease up to their full capacity without the least strain or jar, because all main bearings are roller bearings and the gears on the hoist are direct Spur Gears instead of worm or differential gears.

The load is held securely by an Automatic Mechanical Brake, doesn't depend on the friction of the gears as in worm gearing.

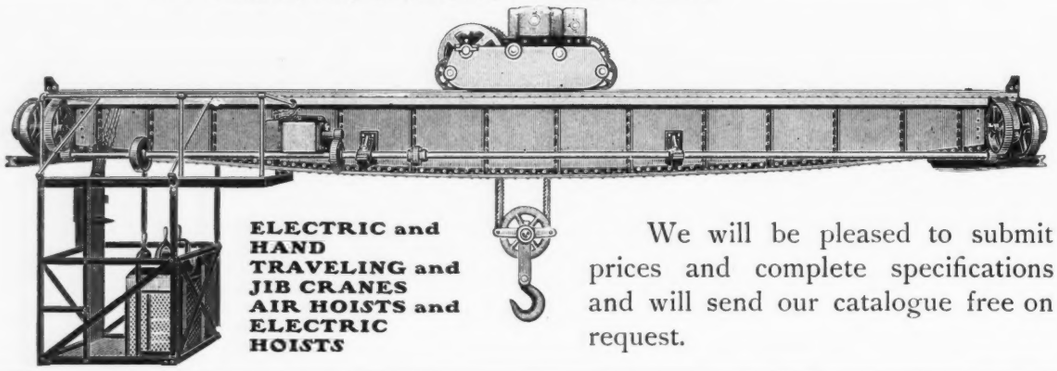
They are easily and perfectly operated from the floor. Send for Catalog.

Maris Brothers, Philadelphia, Pa.

AGENTS: MANNING, MAXWELL & MOORE, New York. Pittsburg. Chicago. Cleveland. Boston.

NORTHERN ENGINEERING WORKS

26 CHENE ST., DETROIT, MICH., U. S. A.



ELECTRIC and HAND TRAVELING and JIB CRANES
AIR HOISTS and ELECTRIC HOISTS

We will be pleased to submit prices and complete specifications and will send our catalogue free on request.

Oven Furnace No. 1 for hardening and annealing.

AN ART

Is what the proper heating and hardening of metal has become to-day. With old-fashioned methods, using coke or coal as fuel, this operation was an incident of manufacture that too frequently became an accident, resulting in spoiled work, lost time and lost profits.

AMERICAN GAS FURNACES make results certain. Any desired degree of heat can be secured by the simple adjustment of two valves; the heat is evenly distributed within a given space and the heating process can be performed with absolute uniformity irrespective of the quantity of work to be treated. Perfect work at a minimum cost secured through our gas furnaces and heating machines.

Write for catalogue showing styles and sizes.

American Gas Furnace Co., 23 JOHN ST., NEW YORK.

Chas. Churchill & Co., London, Birmingham, Manchester and Glasgow. H. Glaenzer & Perreaud, Paris. Schuchardt & Schutte, Berlin, Cologne, Vienna, St. Petersburg.

A New Tool Steel.

"SCHOELLER EXPRESS"

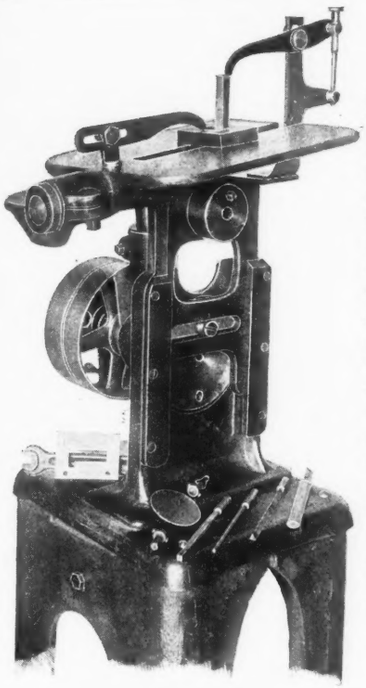
Trade Mark.

"Speed" "Durability"

Superior in Every Particular.

The International Steel and Machinery Company,
247 Centre Street, New York.

Filing Machine.

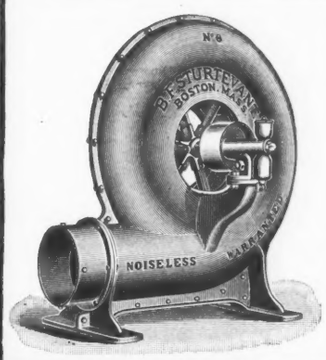


This machine is built for filing Blanking, Trimming, Punching and Drawing Dies, or anything to be filed accurately. By adjusting the table to the graduated plate any desired amount of clearance can be obtained in a cutting die from one to ten degrees. By setting the machine at zero the walls of a drawing die can be filed or lapped perfectly square; something that it is impossible to do by hand.

THURSTON MFG. CO.
419 Eddy Street, Providence, R. I.

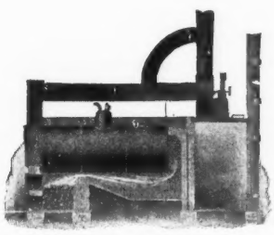
STURTEVANT BLOWERS

of every conceivable form for every conceivable purpose. Built for endurance.



ALSO
Exhausters
Steam Fans
Electric Fans
Engines
Electric Motors
Generating Sets
Forges
Exhaust Heads
Steam Traps
Heating
Ventilating and
Drying Apparatus
Mechanical Draft
154

B.F. STURTEVANT Co. BOSTON,
NEW YORK · PHILADELPHIA · CHICAGO · LONDON.



Where Troubles Cease! We speak of Boiler Troubles!

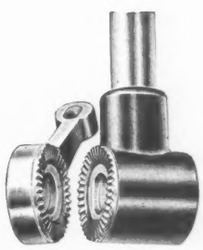
We have a time-tried remedy for **poor** draft and **poorer** combustion.
It's the

"ABC" System of Mechanical Draft.

SEND FOR CATALOG 118 J.

AMERICAN BLOWER CO.
DETROIT, MICH.
NEW YORK, CHICAGO, LONDON.

Never-Slip Surface Gage



PRICES.

6 inch	$2.25
9 "	2.50
12 "	3.50

Tool and Vise Catalogue Free.

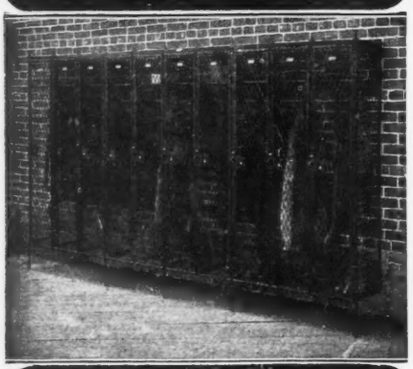
STANDARD TOOL COMPANY,
Athol, Mass, U. S. A.
Manufacturers of MECHANICS' FINE TOOLS.
Agents for Great Britain—C. W Burton, Griffiths & Co., Ludgate Square, Ludgate Hill, London.

RADICAL CHANGES
Result Wherever

Expanded Metal Lockers
Are Adopted.

Aside from affording clean, sanitary, strong, secure places for employees belongings, they insure neatness around the shop

Prevent losses from dishonest employees hiding away things—save time and in many ways prove a decidedly economical innovation.



Send for Catalog—tells how expanded metal lockers pay for themselves.

MERRITT & CO.
1030 Ridge Ave.,
Philadelphia

Made in Four Sizes.

THE CATLIN KEYSEATER.

No. 1 cuts keyseats from 1-8 to 3-4 in. in width, and 10 in. and less in length.
No. 2 cuts keyseats from 1-8 to 2 in. in width, and 14 in. and less in length.
No. 3 cuts keyseats from 1-8 to 2 in. wide and 18 in. and less in length.
No. 4 cuts keyseats from 1-8 to 3 in. wide, and 27 in. and less in length.

Manufactured by
Chattanooga Machinery Co., Chattanooga, Tenn.

Agents for Great Britain: Niles Tool Works Co., 23 and 25 Victoria Street, London, S. W.

STYLE A IN USE.

J. R. DUFF'S HAND DRILLER

For Bit Braces. Chain Attachments and Screw Feed.

This time and labor saving Tool can be quickly applied, works easily and drills metals to 1 inch hole.

Well finished, strongly made and moderate in price. Three styles, A, AA and B. Send for prices and full description.

DUFF MACHINE CO.,
8 Western Ave.,
LOWELL, MASS.

One Cent

is all that it costs to lace a 5-inch belt with coil lacing by the

Jackson Belt-Lacing Machine.

Three minutes is all the time required to lace a 6-inch belt, and it lasts longer than any other lacing. Why continue to waste time by using the old method. The machines are cheap enough.

Send for prices.

Diamond Drill and Machine Co.
Furnace St., Birdsboro, Pa.

WOODMAN & HUDSON'S

SPEED INDICATOR.

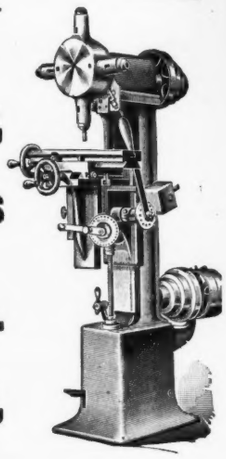
An ingenious little instrument for ascertaining the correct speed of Dynamos, Steam Engines, Shafting, Floor Machines, etc. No first-class mechanic, superintendent or factory should be without one. They are adapted to hollow or pointed centers, and are absolutely correct. Every indicator is handsomely nickel-plated and of convenient size to carry in the pocket.

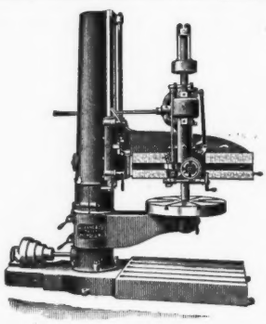
PRICE: Split Cap, adapted to either pointed or hollow centers, $1.00
Plain Cap, for hollow centers only, .75.
We also keep a Double Registering Speed Indicator.
PRICES ON APPLICATION.

The R. Woodman Mfg. and Supply Co.
63 Oliver St., Boston, Mass.

QUINT'S TURRET DRILLS, MILLING MACHINES and TAPPING MACHINES.

Made by
A. E. Quint,
HARTFORD, CONN.





A Satisfied Customer

is the best advertisement a manufacturer can have. We have a pretty long list of customers for our Radial Drills, and we are willing to refer you to any one or all of them. We make our drills right, and they never fail to give satisfactory service. More work with less effort can be done on our drill than on any other. One conveniently located lever controls all the movements of the spindle. Strong, accurate, convenient. Circulars if you are interested.

THE WM. E. GANG CO.,
Queen City Ave. and Pine Tree St.,
CINCINNATI, O.

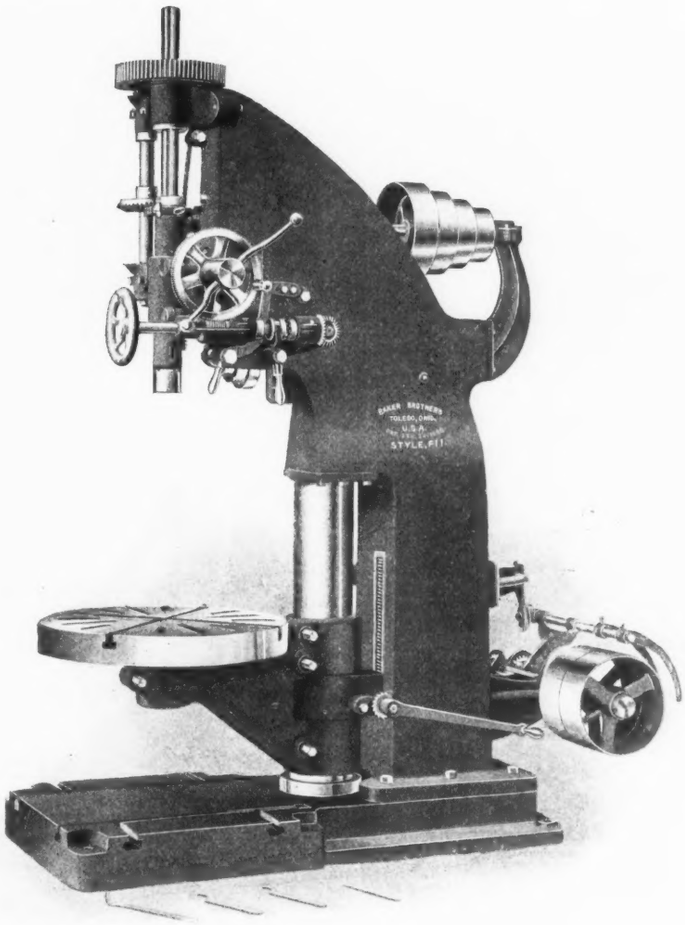
We manufacture a Complete line of

.. Drills

for light work, one or more SPINDLES, hand or automatic feed, of thorough workmanship and strictly up to date. Prompt delivery on regular styles. New catalogue on application.

Dwight Slate Machine Co.
HARTFORD, CONN.

Chas. Churchill & Co., Ltd., London and Birmingham.
Schuchardt & Schutte, Berlin, Germany.



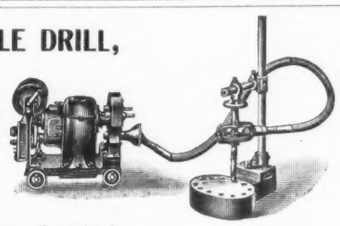
Save 25% on your drilling, and at the same time do **more accurate work,** by using our drills, because they are more powerful and stiffer. **Compare the cut with any 32 Inch Drill on the market.** There is no possible spring in the column and table. The spindle is driven by large spur gears instead of bevel gears. Wide range of speeds and feeds.

SEND FOR CATALOGUE.

BAKER BROTHERS, - TOLEDO, OHIO.

The Practical Value of the.. **ELECTRIC PORTABLE DRILL,**

STOW FLEXIBLE SHAFT and GENERAL ELECTRIC CO. MOTOR



As a tool for Boring, Grinding, Reaming, etc., has been shown by successful work in places most difficult of access.

See Catalogue 7—self explanatory.

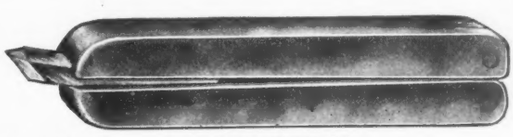
STOW FLEXIBLE SHAFT CO., **Twenty-sixth and Callowhill Streets,**

FREDERIC SCHOFF, Prop. **PHILADELPHIA, PA.**

New Tool Holder.

PAT. APPLIED FOR.

No Set Screw or Bolt.



SIMPLE, RELIABLE, CHEAP. *SEND FOR PARTICULARS.*

STOREY & SONS, **Mount Holly, N. J.**

A SINGLE COLUMN

of tersely written copy, which talks business and brings out the strong points of your product, will do more than a dozen pages of matter which lacks force and originality.

The value of any space depends largely on the character and quality of the matter used in it; not the size of space.

What's the use of having a poor ad in a good medium, or good matter in a weak medium?

Many advertisers spend all their money for space and nothing for the writing and illustrating of bright, forceful, clever ads.

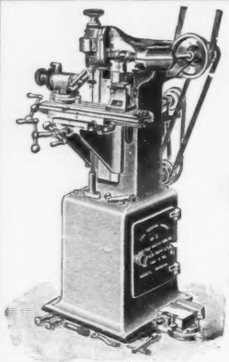
Success in advertising demands a perfect combination of good ads in best mediums, up-to-date and attractive literature, a follow-up system and a sensible plan of campaign.

It is economy to consult with an experienced specialist and have your ads prepared and changed every month and made into interesting chapters—a continued story of your products.

Lots of advertisers consult me about mediums—the right kind—the amount of space to use—how to use it—and have me write and illustrate their ads and prepare their booklets, circulars, catalogs, flyers, and everything that comes under the head of publicity.

I show them how to get true efficiency out of their advertising without adding a single $ to the expense. May I tell you how I do it?

CLARENCE P. DAY, A.C.
NASSAU-BEEKMAN BUILDING
140 NASSAU ST., NEW YORK.
TEL. 2671 JOHN.



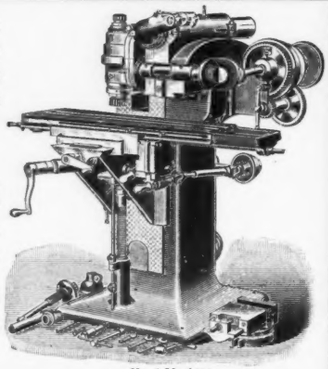
No. 0 Machine

No milling machine outfit for tool room or factory use is complete without one or more

Van Norman Duplex Machines

We have 3 sizes on the market; Nos. 0, 1 and 2.

Let us send you descriptive catalog.



No. 2 Machine.

MANUFACTURED BY

For sale by Manning, Maxwell & Moore in Boston, New York, Philadelphia, Pittsburg, Cleveland and Chicago.

WALTHAM WATCH TOOL COMPANY,
Springfield, Mass., U. S. A.

Modern. Reliable. Book N on Request.

Electric Traveling Cranes.

BRANCH OFFICES:
New York,
Chicago,
Pittsburg,
Philadelphia.

Pawling & Harnischfeger,
Main Office and Works:
275 Oregon Street, Milwaukee, Wis., U. S. A.

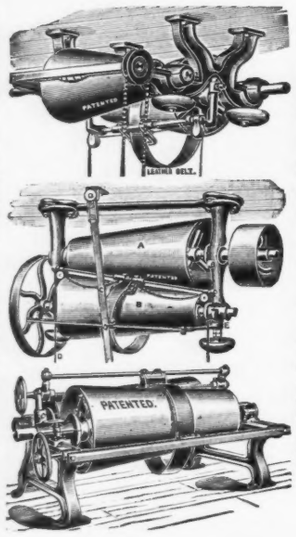
THE REEVES Variable Speed Transmission

Applicable to any mechanical proposition requiring variable speed.

1902 CATALOGUE.

REEVES PULLEY CO., Sole Manufacturers, COLUMBUS, IND.

Evans Friction Cone Pulleys



1 to 40 H. P. for changing speed of machinery while running. Send for Catalogue.

G. F. EVANS, 85 Water St., BOSTON, MASS.

Here is the labor saving tool Cuts all rings absolutely true.

And this is our regular cut-off tool which is the finest on the market. We are headquarters for cutting-off tools. Send for catalogue.

C. P. MINGST,
Evansville, Indiana.

LOOK AT THIS LINE OF

OIL HOLE COVERS AND CUPS.

MADE IN SEVERAL SIZES.

Send for Price List and Samples, and Automatic Opening Die Catalogue.

FOR SALE BY JOBBERS AND DEALERS.

W. W. & C. F. TUCKER, Hartford, Conn., U.S.A.

Foreign Agents, Fenwick Freres & Co., Paris, France.
Buck & Hickman, London, England.

GEARS

Important Points

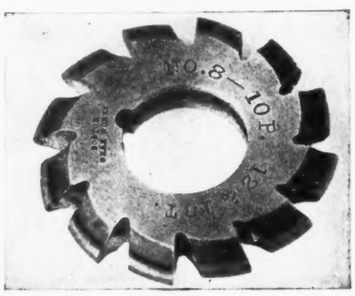
In the successful manufacture of any line of goods are

Experience, Skill and Equipment.

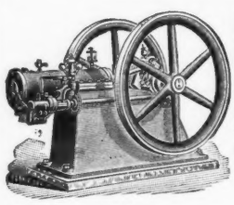
We have all three and if you are in need of **GEARS** of any style, size or pitch, we are the people to do the work.

We also manufacture Cutters for all kinds of work, Hobs, Cams, Sprockets and Chains, Universal Ball Joints and Bearings.

We would like you to send for Catalogue K 2; shows 4,100 styles and sizes of gears.



Boston Gear Works,
152 Purchase Street,
Boston, Mass.



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embodying new and important features in design and operation. Send for Catalog V.

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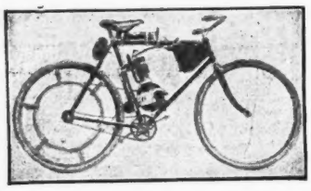
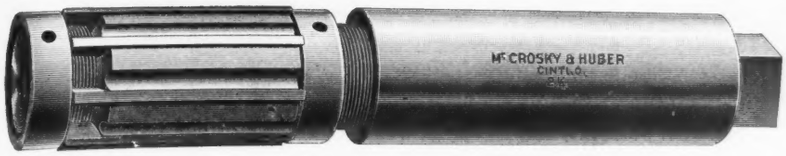


BICYCLE GASOLINE ENGINE CASTINGS $7.50.

Your address brings circulars and full particulars. Better write today, we can please you.

EUREKA MFG. & SUPPLY CO., St. Paul, Minn.

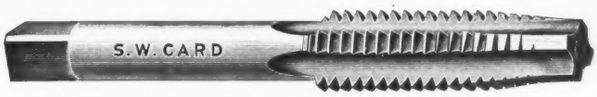


McCrosky & Huber Reamers are Guaranteed.

If there is anything wrong with one of them, you've only to send it back and we will make it right. They are well designed and carefully constructed; the adjusting collars are carbonized, the blades are made of the best material, tempered and ground, and when worn out are easily replaced. Only a few seconds required to obtain any adjustment—no hammering or grinding either. Our Universal Adjustable Reamers may be truly said to *save more time* in the shop than any tool on the market. All styles and sizes. Booklet and price list.

McCrosky & Huber, 210 Lawrence St., Cincinnati, O.

There are Taps, Good Taps and Then Card's Taps.



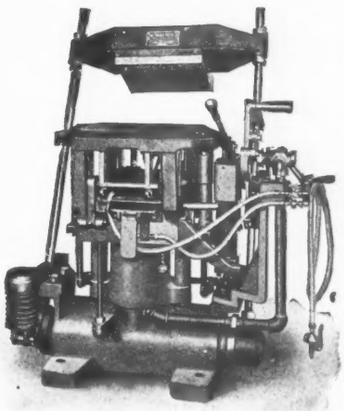
Consult Card's Catalogue for anything you need in the line of screw cutting tools, and you won't need to look further. Full assortment carried in stock.

S. W. Card Mfg. Co., Mansfield, Mass., U. S. A.

Time is Valuable

AND

Too Expensive to Waste.



To reduce the cost of lost time—double the quantity of work done, without losing in quality and you strike "pay dirt" every time.

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represent the perfection of Foundry labor saving devices—they save time, labor, material and pattern cost, and always make uniform castings.

If any tool is needed in your plant isn't it a **Tabor Vibrator Molding Machine?**

Send for catalog.

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Machinery Trust, Ltd., 189 Fleet St., E. C., London, Eng.
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RAPPING PLATES.

FRASER'S PATENT.

Twenty styles and sizes of these plates made of best quality malleable iron. Rapping holes, tapped draw holes and screw holes. Take a stronger hold on the wood than any other kind.

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Steel Barrels, Kegs, Pails, Boxes, Etc.

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Painted, Galvanized or Black.

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Patented.

A Science

We have reduced Pattern Making to a science, and by adopting the latest and most approved methods are able to produce absolutely accurate patterns in the shortest time and at reasonable prices.

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NAME PLATES

FOR MACHINERY.

We make name plates for some of the largest makers of machinery in the United States, and we would be pleased to send you sample and quote price.

NO PLATE TOO LARGE OR TOO SMALL.

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14-INCH

WATER TOOL GRINDER.

SEND FOR CIRCULAR.

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John T. Usher.

320 pages, 257 illustrations. Price $2.50. Contains more shop kinks, useful devices and quick methods of doing work than any book we know of. Every machinist will find it useful and no shop foreman can be without it.

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That in cutting threads with solid dies and running back over thread cut you waste a lot of time? Why it means at least a 60 per cent increase in output to use

Adjustable Self-Opening Die Heads.

That's an increase and saving that deserves considering; besides, our DIE HEADS can be used for a number of diameters by simply changing the dies.

Extra dies cost but little more than solid dies and will last three times as long.

Let us send you our Catalog; tells all about the efficiency and accuracy of our DIES and Taps.

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We cannot temper your copper, bronze or aluminum forgings, but have a way of treating to produce different degrees of stiffness.

Our annual tonnage output of first-class machine drop-forgings, (wrenches our specialty) is without equal in the world.

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Drop-forgings only,
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IRON TOOL-STEEL SOFT-STEEL COPPER

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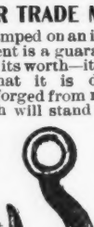
OUR TRADE MARK

Stamped on an implement is a guarantee of its worth—it tells that it is drop forged from material which will stand the wear and tear for which it was intended. We make anything in drop forgings and have exceptional facilities for turning out work promptly. Write for book and we'll send it the day we receive your letter.



Keystone Drop Forge Works,
20th and Clearfield Streets,
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R. POOLE & SON CO.
ENGINEERS, FOUNDERS AND MACHINISTS.
BALTIMORE, MD.
MANUFACTURERS AND DESIGNERS OF ALL KINDS OF
HEAVY MACHINERY,
REQUIRING FIRST CLASS WORKMANSHIP AND MATERIALS.
BAND, ROPE AND FLY WHEELS. FRICTION CLUTCHES, SHAFTING, PULLEYS AND HANGERS.
MACHINE MOLDED AND PLANED GEARING.
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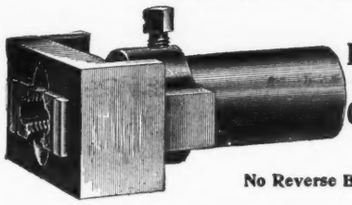
CIRCULARS ON APPLICATION.
IRON CASTINGS 30,000 LBS. TENSILE STRENGTH.

CRANE FITTINGS
ESTABLISHED 1855

ERRINGTON AUTO-TAP AND DIE CHUCKS.

39 CORTLANDT ST., NEW YORK.

ADJUSTABLE OPENING DIE.



End-Slip while Cutting.

No Reverse Belt.

Opens Automatically, and Closes (by Foot) while Rotating. The Only Automatic Die for Brass Lathes. Small Swing when Stationary.

AUTO-REVERSE TAPPING CHUCK

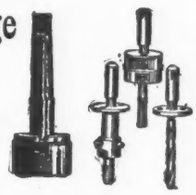
No. 0 taps to 3/4. No. 3 (pipe) taps to 1
No. 1 taps to 5/8. No. 4 taps to 1 1/4.
No. 2 taps to 1. No. 5 taps to 2.

Drives tap in, stops automatically at bottom of hole; backs tap out (quick return) without stopping or reversing drill press spindle.

Fits any Drill Press.

The Only Automatic Reverse.

Quick Change Tool-holders for Reversible Drill Press.



Drills, Taps, Sets Studs IN LINE.

NO { STOPPING, REVERSING, MOVING WORK.

No Special Taps

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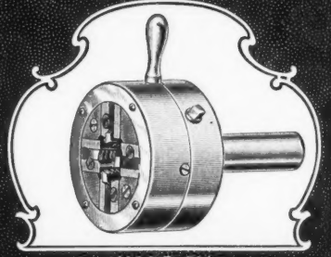
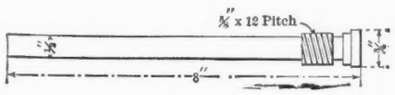
WALLACE
SELF-OPENING ADJUSTABLE
DIE HEADS.
EIGHT SIZES.



MADE BY
MODERN TOOL CO.,
ERIE, PA., U.S.A.

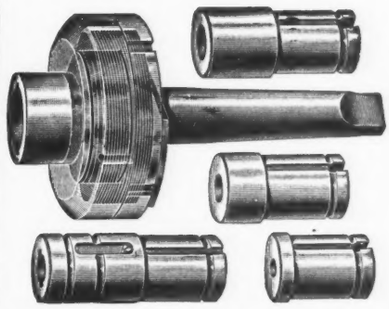
As an Apprentice Boy

You used Set Tools and wasted a lot of time changing work in the Lathe. The modern shop uses BAYLDON'S INTERCHANGEABLE TOOL POSTS, and instead of changing the work changes the Tool Post in which are set tools for the entire series of operations.



Here is a record made by a Set of Interchangeable Tool Posts on an ordinary 13" Lathe using NO special tools, NO box tools, NO dies. Time setting up ½ hour—time turning a hundred pieces as shown in cut 16½ hours—total time 17 hours—TEN MINUTES EACH.

Bayldon Machine and Tool Co.,
18 Morris Street,
Jersey City, N. J.



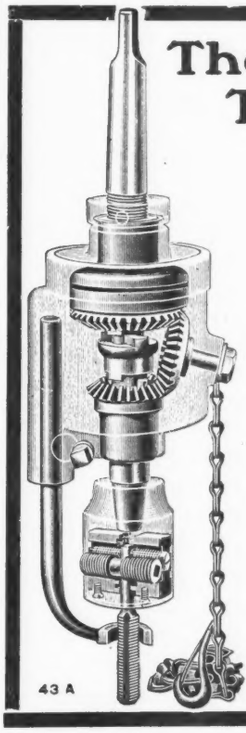
THE
Safety Drill & Tap Holder

Is the only attachment for the purpose that gives universal satisfaction, and is

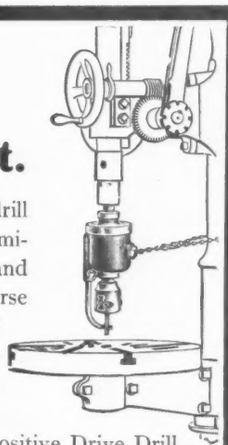
UNEQUALLED for Efficiency, Convenience, Rapidity, Accuracy and Simplicity.

Nothing to Break or get out of Order. Made in 4 sizes, covering from 0 to 2½ in. diameter.

The Beaman & Smith Co., Providence, R. I., U. S. A.



The "Star" Tapping Attachment.



Will practically convert any drill press into a full fledged semi-automatic drilling, tapping and stud-setting machine. No reverse belts required, no stopping of machine, no special taps, no broken drills or taps. Has friction and positive drive. Furnished with "Seneca" Positive Drive Drill Chuck. Warranted to give satisfaction. Sent on 30 days' trial.

No. 1 Taps 1-16 to 5/8 inch.
No. 2 Taps 1-16 to 1 inch.

Send for Booklet D.

The Seneca Falls Mfg. Co.
330 Water St., Seneca Falls, N.Y., U. S. A.

43 A

Established a Century Ago.

JESSOP'S STEEL **Tools, Drills, Dies, Etc.**

ALL KINDS IN STOCK.

WILLIAM JESSOP & SONS, Ltd. Manufactory, Sheffield, Eng. Chief American Office, 91 John St., N. Y.

Grand Prix, Paris, 1900.

DURABLE, FAST CUTTING. **VITRIFIED WHEELS.** ACCURATE, ECONOMICAL.

EMERY AND CORUNDUM.

VITRIFIED WHEEL COMPANY, Westfield, Mass., U. S. A.

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A SHORT STORY HAS MOST READERS.

STERLING

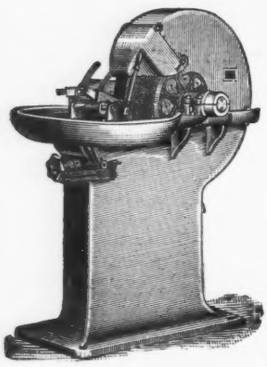
"THE STERLING" PAT. APR. 10 1883 EMERY AND CORUNDUM WHEEL

Sterling Emery and Corundum Wheels

Solve the grinding problem.

STERLING EMERY WHEEL MFG. CO.

TIFFIN, OHIO, U. S. A.



THESE MACHINES

save valuable time and pay for their cost each year over grindstones as a free gift.
Sold under a positive guarantee.
Self-locking Belt Shifter, fine adjustment and water regulation, and other features described in 1901 catalogue.
We make a large line of high-grade Emery Wheels and Machinery—also Diamond Tools all described in catalogue.

BRIDGEPORT SAFETY EMERY WHEEL CO.
BRIDGEPORT, CONN., U. S. A.

Carborundum

takes the nicks out of the scythe of time—does more work in a day than other abrasive materials do in two or three or four days—and works more days before wearing out. Carborundum grinding wheels are a money-saving proposition in every shop where abrasives are used.

We make a strong guarantee—Write for it.

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Niagara Falls, N. Y.

THE ABRASIVE MATERIAL CO. PHILADELPHIA PA.

"ABRASIVE"

An Emery Wheel composed of
Best materials
Rightly compounded to make
A wheel we can guarantee
Satisfactory for grinding purposes.
It cuts free and fast.
Vitrified process used in construction.
Every wheel guaranteed satisfactory.

Report from a trial order by one of the largest steel companies: "Your wheel ground 70,000 pieces against 35,000 of the wheel we had been using.

Abrasive Material Co.
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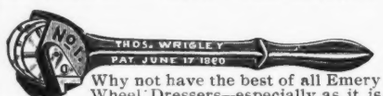
20-inch Water Tool Grinder.

Base on floor 16 in. x 24 in.
Emery Wheel, 20 in. x 2½ in.
Weight 600 lbs

The pump on this grinder is entirely above the water, cannot leak, requires no packing, and can be stopped and started at will.

Catalogue N shows our full line of Emery Wheels and Emery Wheel Machinery. Mailed free.

IS BEST—AND CHEAPEST



Why not have the best of all Emery Wheel Dressers—especially as it is also the CHEAPEST? Clean cutter, rapid worker, self-sharpening and self-hardening. Satisfaction guaranteed.

$1.50 DELIVERED. Extra Cutters 15c. a Set.
Thos. Wrigley, 306 Dearborn St., Chicago.

OUR SPECIALTY,

Automatic Machinery for making Wood Screws.

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Get Samples and compare prices of our **Emery Wheels.**

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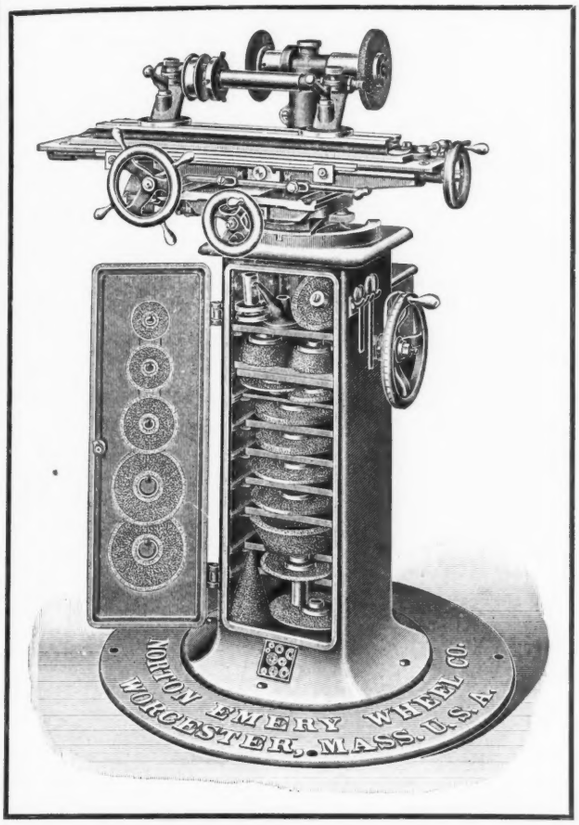
Springfield, Mass.

WALKER UNIVERSAL TOOL AND CUTTER GRINDER.



ESPECIALLY ADAPTED TO TOOL ROOM USE.

For such work as grinding to size straight and taper lathe arbors, cutter and reamer blanks, discs and gauges, or any cylindrical or conical grinding usually done upon centres or in the chuck; for sizing internal work in an accurate manner and sharpening all forms of straight or taper fluted reamers, spur cutters, bevelled cutters, face cutters, end cutters, and formed cutters; also rose reamers, counterbores, taps, countersinks, etc.

AUTOMATIC FEED ATTACHMENT.

NORTON PRODUCTS ARE THE STANDARD.

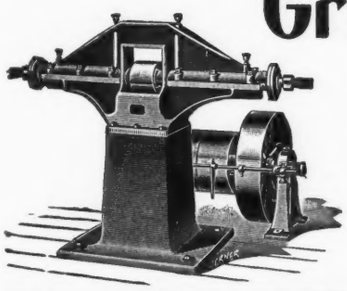
SPECIAL ILLUSTRATED CATALOGUE OF THIS UNIQUE MACHINE FURNISHED UPON APPLICATION.

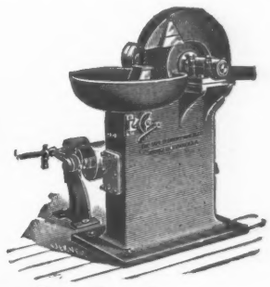
Manufactured by

NORTON EMERY WHEEL CO.

WORCESTER, MASS.

Emery Wheels and Grinding Machinery





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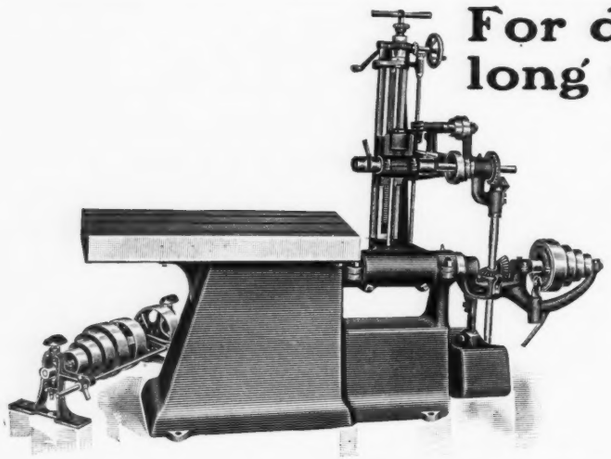
THE SAFETY EMERY WHEEL COMPANY, Springfield, Ohio, U. S. A.

SHELBY Cold Drawn Seamless Steel Tubes.

Seamless Tubing is adapted for various mechanical and engineering purposes, and has been used with very satisfactory results; machines readily and cuts free and clean. Can be annealed for bending or forming into special shapes. Standard sizes carried in stock and furnished promptly. *Send for list.*

SHELBY STEEL TUBE CO. :: :: :: GENERAL SALES OFFICE: PITTSBURG, PENNA.



For drilling and tapping on long work

which cannot be handled on an upright drill, the B. F. BARNES COMPANY Horizontal Drilling Machine fills the bill completely.

A strong, well designed, modern tool in every particular.

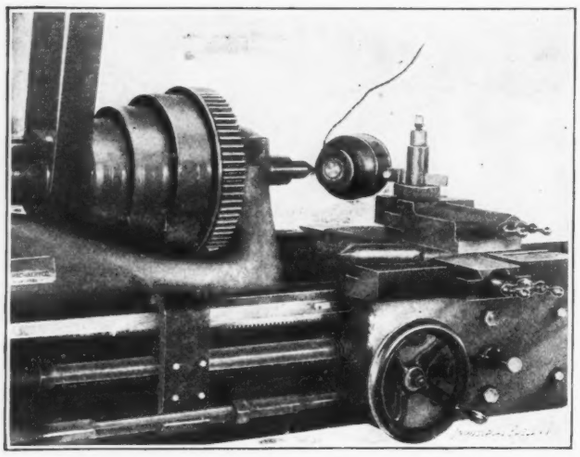
Will drill up to 1 1-2 in. and tap up to 1 1-4 in.

Further details on application.

B. F. Barnes Company,
Rockford, Illinois.

New Center Grinder

The neatest attachment yet devised for the engine lathe. An Electric Grinder weighing only 20 pounds, motor and all; held in the tool post like any lathe tool. Electric current taken from the nearest lamp socket.



The motor is entirely enclosed and a new feature is a hollow armature shaft within which the solid shaft carrying the emery wheel can be made to slide, thus giving the reciprocating motion to the emery. This makes a particularly neat and convenient arrangement, as it does away with clumsy slides. An invaluable machine for center grinding, small grinding on the lathe and cutter and reamer grinding.

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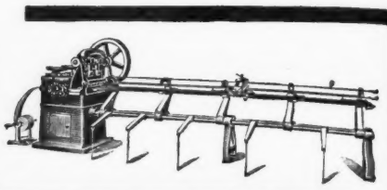
MILWAUKEE, WIS.

Labor Saving



Automatic Machinery is our specialty.

We make anything that you require or may need in machinery for straightening and cutting wire sheet metal and strip stock accurately and quickly.

If your work requires a number of holes drilled or a number of rivets made, send for our book which tells about our Riveting and Drilling Machines and our other specialties in Automatic Labor Saving Machinery.

The F. B. Shuster Co.
Formerly John Adt & Son,
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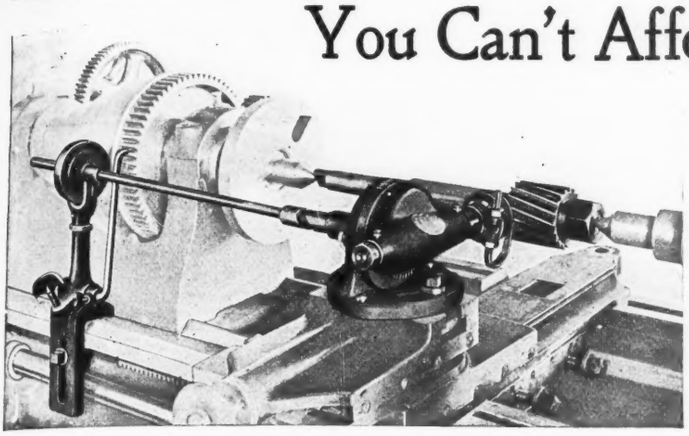
For Drilling Small Holes—

Say one-half inch or less, **Our 14-inch Single Spindle Bench Drill** is as substantial, accurate and convenient a tool as can be made. The spindle has three speeds, cut steel rack and pinion feed, and adjustable stop to gauge the depth of holes. Being counterbalanced by weight inside of frame it is extremely sensitive and uniform to the touch. A particularly valuable tool for machinists' and tool room work. Special circular sent on request.

The Chapin-Love Machine Co.,
127 Worth Street, New York City.

You Can't Afford to use Dull Tools



when you can get a complete Reamer and Cutter Grinder at so small an outlay.

The American Grinding Attachment

will save its cost in a very short time and you will get **more** and **better** work by its use. Guaranteed in Every Particular.

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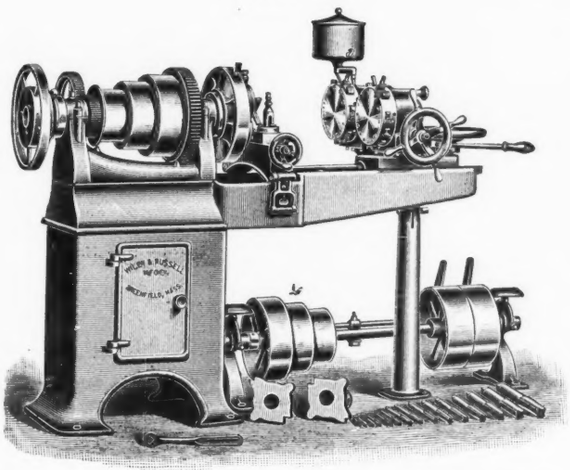
Chas. Churchill & Co., Agents, London, England.

Green River

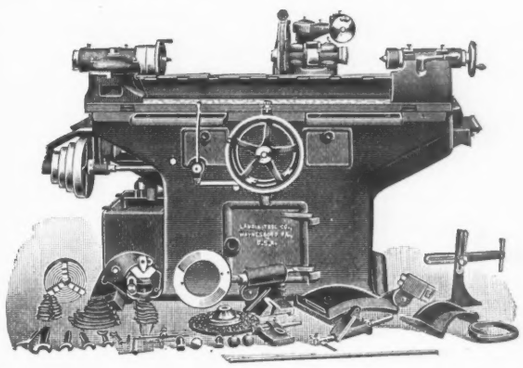
Opening-Die, Bolt-Cutter, Nut-Tapper, Pipe-Threader and Cutting-off Machine No. 55.



No. 55 Machine with Plain Countershaft, Cutting-Off Attachment, Extra Scroll Chuck on back end of spindle, Nut-Holders, etc. Send for Catalogue.

WILEY & RUSSELL MFG. CO., GREENFIELD, MASS., U.S.A.

Universal Grinding Machine No. 3.



The capacity of this tool is 12 inches swing and 42 inches between centers. It possesses all the features peculiar to Landis Grinding Machines, solid bed, heavy heads and thorough provision for carrying away all water used; has twelve changes for speed of work and combines the best material and workmanship throughout.

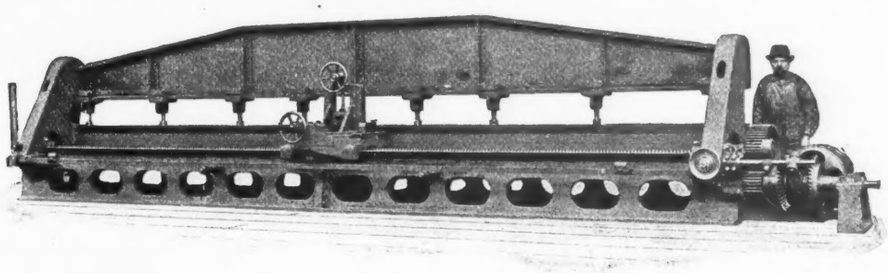
Our catalogue shows full line of Grinding Machines.

LANDIS TOOL COMPANY,

Waynesboro, Pa., U. S. A.

Walter H. Foster, Manager, New York. Hill, Clarke & Co., Boston and Chicago. C. W. Burton, Griffiths & Co., London. Ad. Janssens, Paris. Schuchardt & Schutte, Berlin, Cologne, Vienna, Brussels, Stockholm and St. Petersburg.

When you want a Plate Planer come to us. We have built some of the largest in the country.



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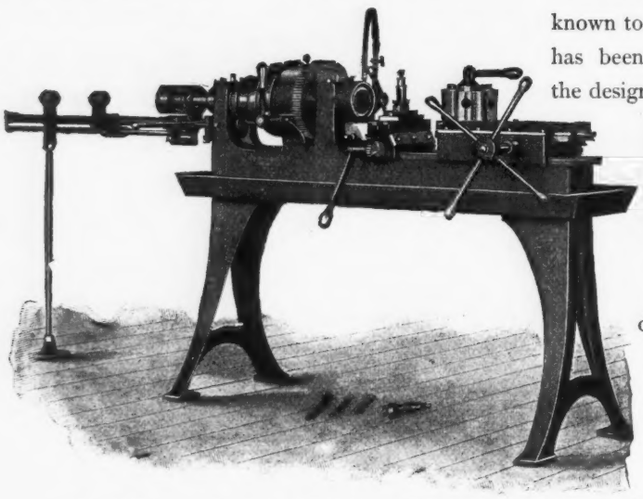

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Built in eight different sizes and capacities.

With Attachments.

No. 3 Screw Machine with Geared Friction Head.

Catalogue on Request.

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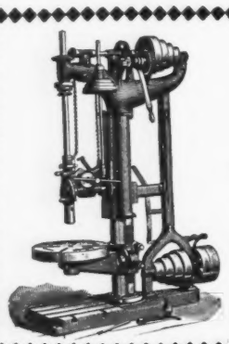
CABLE ADDRESS, "PEARSON," CHICAGO. LIEBER'S CODE.



"Hamilton"
Engine Lathes, Radial and Upright Drills.

Guaranteed to be first-class in every respect. If not satisfactory, they may be returned at our expense. Write for free catalog.

The Hamilton Machine Tool Company,
Hamilton, Ohio, U. S. A.

AGENTS:—The Garvin Machine Co., New York, Philadelphia and Berlin. Selig, Sonnenthal & Co., London.

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14 INCH. 16 INCH.

GODDARD LATHES.

Improved design. Best material generously used in construction. First-class workmanship. Convenient, reliable, money making tools. Let us explain more fully.

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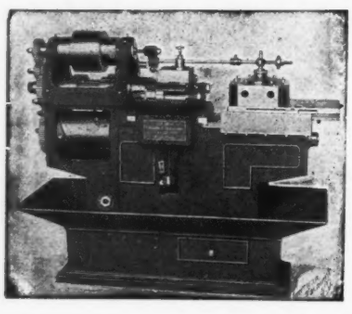
FOREIGN AGENTS: Thos. A. Renshaw, London, England. V. Lowener, Copenhagen, Denmark. Frank Kustner, Dresden, Germany. G. Ernesti, Milan, Italy.



The New Forming Machine

Multiple Spindle - Full Automatic

This Machine is replete with automatic movements which change the feed of cutters at any point in course of forming a part. A change of speed of spindles from 150 to 380 revolutions and back again, also reversing the motion of spindles at any point desired in an operation, while the speed may be increased or diminished to the requirements of work in hand at will. Inquire of

JAS. D. MATTISON,
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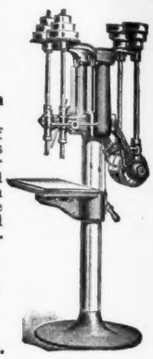
New Sensitive Drill

With Improved Driving Mechanism



The particular advantage of this tool over others of its class is the independent drive for each spindle. On this drill only *one straight* belt for each spindle is needed. We make this style drill with 2, 3, 4 and 6 spindles. Send for descriptive circular.

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SUCCESSORS TO
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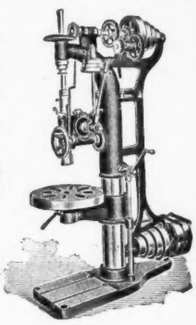
24, 26 and 28 in. SIBLEY & WARE DRILL



with Stationary Head, Back Gears, Self-feed, Quick Return, Automatic Stop, Graduated Quill and Reverse Motion. A very powerful machine, capable of turning out a large amount of work at a low cost.

Sibley & Ware,
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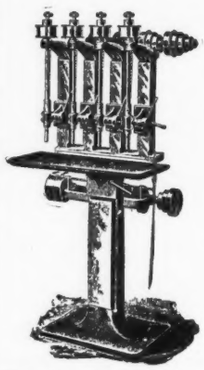
Sensitive Drills!



1 to 8 Spindles with or without automatic feed.

Adjustable and Double-Head Traverse Drills.

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Tapping Machines. **Centering Machines.**

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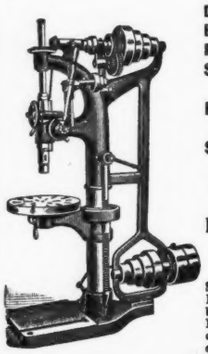

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SPECIAL IRON, WIRE AND WOOD WORKING MACHINERY.
Designed and Built to Order.

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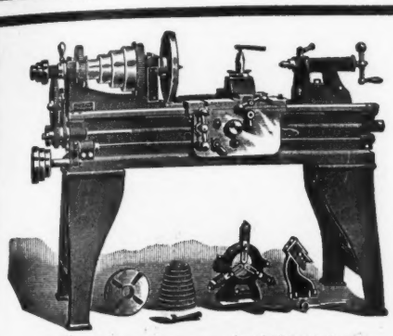

Sebastian Lathes for Light Manufacturing.

9 to 15 inch swing.

These tools are carefully constructed from the latest and most approved designs, and workmanship, material and finish are guaranteed. Special attention has been given to durability and convenience of handling, all wearing surfaces are ample and fitted in the best manner. Our Lathes produce GOOD work with rapidity and economy.

SEBASTIAN LATHE CO., 129-131 Culvert Street, Cincinnati, Ohio.

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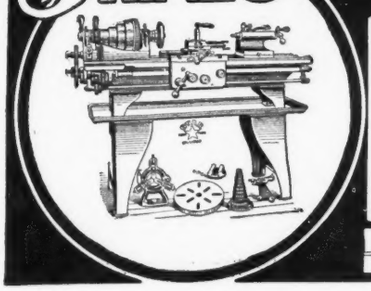

As no other lathe can. It makes work lighter. It brightens the prospect of its user's profits. It belongs in your tool room.

"Star" Lathes are heavy, rigid, and above all else, accurate. Can furnish with Draw-In Chuck, Gear-Cutting, Milling and Taper Attachments.

9, 11 and 13-inch Power Lathes.
9 and 11-inch Foot Lathes.

Sent on Trial. Send for Catalog "B".

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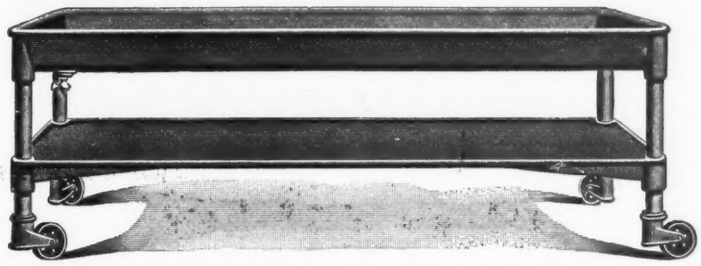
130 WATER ST., SENECA FALLS, N.Y.

Doesn't take a Minute

To turn this lathe pan **end for end**—swivel casters facilitate movement in any direction—then when you put an occasional brass job on your lathe there is no need of mixing the brass with the iron chips already accumulated in the pan. That's a point to remember.



Our New All-metal Lathe Pan is just the right height to roll under the lathe easily. The lower tray holds the lathe tools and pieces of work, the upper tray, provided with outlet and strainer, catches the chips and oil. No excuse for splintered, oil-soaked wooden trays with this pan on the market. Price right too. Circulars mailed on request.

Adopted by the United States Government at different points.

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New Britain, Conn., U. S. A.

Lathes
Shears
Punches

W. C. Young Mfg. Co.

15 to 23 Hermon St.

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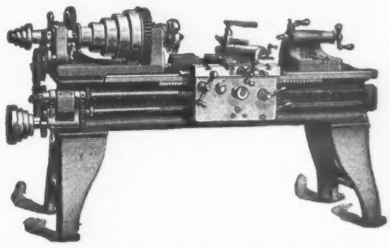
Engine Lathes

17", 19", 22" and 24" swing.



BEDS ANY LENGTH DESIRED.

All threads cut without stopping the lathe or reversing the lead screw.

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S. E. Cor. Cook and Alfred Sts.,
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Also Builders of

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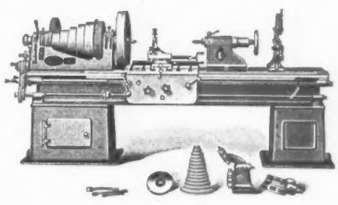
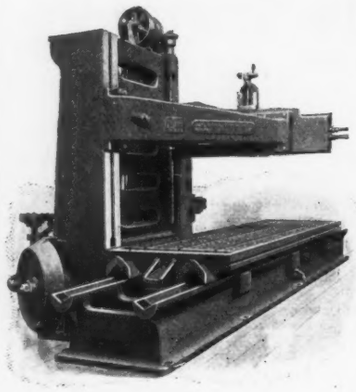


Manufacturers of

IRON WORKING MACHINERY,

Planers, Lathes, Slotters, etc.



The Wide Range of Work that can be done on the

Open-Side Iron Planer

is well worth considering in a shop where a variety of work is turned out. These Planers are not only strong, rigid and capable of the heaviest kind of work, but their peculiar construction, having only one post, makes it possible to use a comparatively small tool of this type for work that would require a much larger and more expensive machine of the other style.

The **Open-Side** leads all other metal planing tools.

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Shapers

Send for Circulars of Our Improved Tools

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Treatise on Gears, G. B. GRANT Price, $1.
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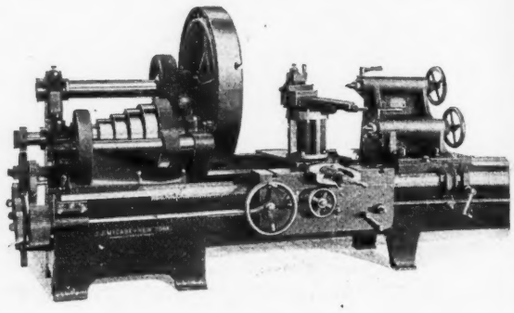
McCabe's New Heavy Pattern Double Spindle Lathe

Catalogue and list of users at your service.



IS every day finding a wider field of usefulness, because every day some new manufacturer wakes up to the fact that it's just the tool he needs. Double the screw cutting capacity of the ordinary lathe, 26-inch swing back geared for ordinary work, 48-inch swing triple geared for the heavy job. See the advantage?

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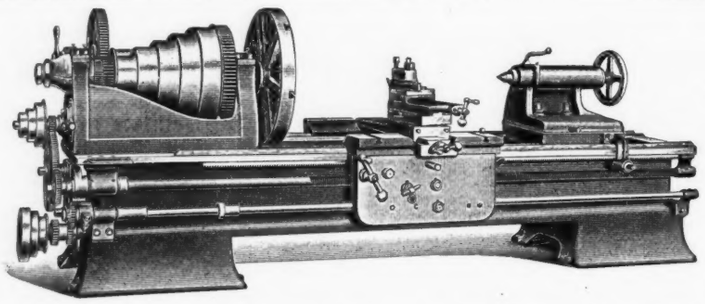

The largest engine lathe we build is our 30 in. swing, of which this cut is an accurate representation. It weighs 8800 lbs. with 12 ft. bed. It has babbitted spindle bearings, hollow spindle, combined gear and belt feed and belt tightener. It also has automatic stop to feed, our new universal toolholder, etc. We are building more lathes of this size than ever before. They are thoroughly up-to-date, absolutely reliable and perfectly satisfactory to the lathe users of largest experience and most critical discernment in buying, who, when in want of a 30. in. lathe, choose the "Reed."

We build engine lathes as small as 10 in. swing. Write or see us or our agents.

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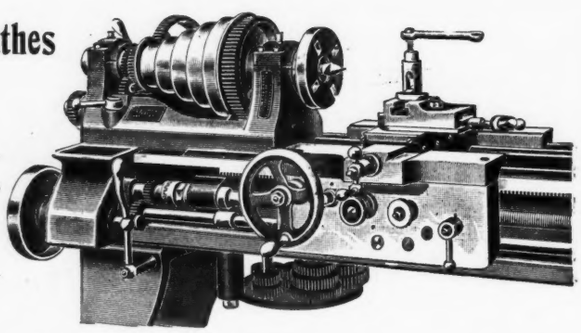
One of the best Lathes on the market.

All improvements—all the good features a lathe should have.

Send for our special circular of this tool.



FLATHER & CO., Inc., Nashua, N. H., U. S. A.

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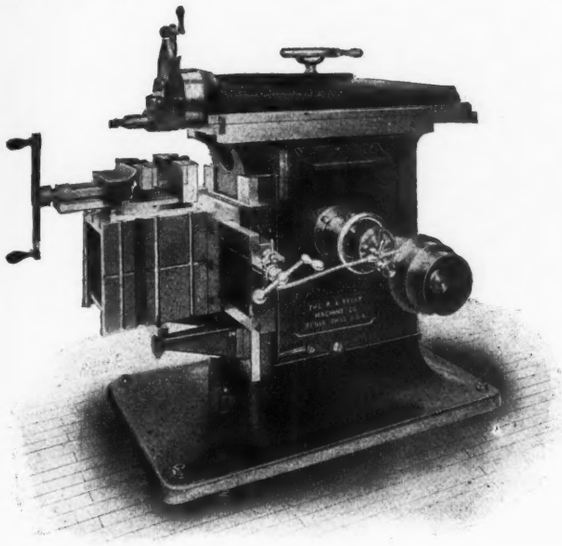
For Good Service.

Made Right, Sold Right.

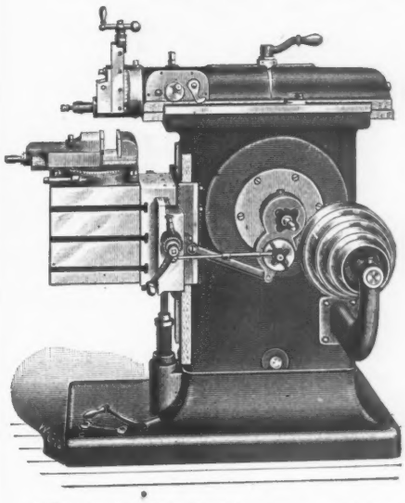


SIZES:
Plain Geared Crank Shapers, 15″, 16″, 20″.
Back Geared Crank Shapers, 20″ and 26″.

The engraving shows our 26 inch machine which can be used as a back-geared or plain shaper, and our circulars give details of all sizes.

The R. A. Kelly Company, Xenia, Ohio, U. S. A.

The NEW CRANK SHAPER



This tool is fitted with a new combination crank motion entirely different from any other crank shaper. Cutting speed is even with quick return of 4 to 1.

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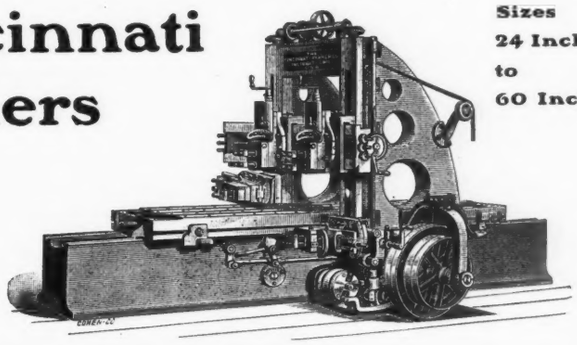
Sizes 24 Inch to 60 Inch



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Our planer book gives the points—sent free.

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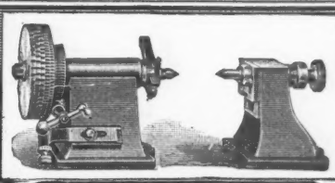

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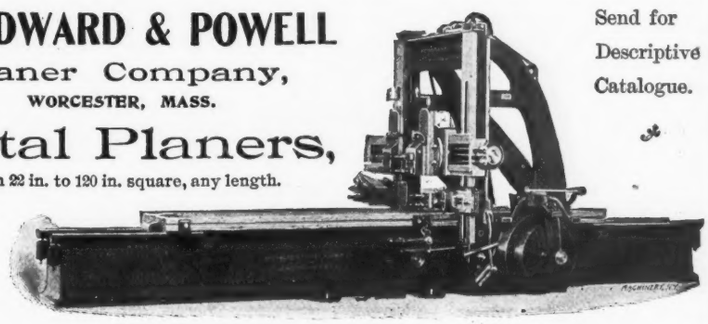
WORCESTER, MASS.

Metal Planers,

From 22 in. to 120 in. square, any length.



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All sizes in stock.

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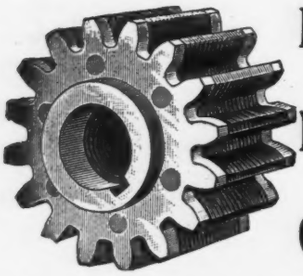

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Full Automatic Universal.

First class in every way for Spur, Bevel, Worm and Internal Gears. We also cut Gears of all kinds and sizes.

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Cut Theoretically Correct.

Special facilities for cutting worm, spiral and internal wheels.

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Helical Gears, single or double. Any angle or ratio to 6 feet in dia. Worms and Worm Wheels and Bevels to 6 feet and Spur Gears to 7 feet in dia.

THE WALKER GEARS

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OUR LINE OF GEARS

Includes Bevel, Spur, Worm, Spiral, Skew, Internal, Pattern, Rack, Ratchet Sprocket Gears.

Send for Catalogue and Price List.

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BEVEL, SPUR, INTERNAL, SPIRAL, WORM

GEAR CUTTING

UP TO TEN FEET DIAMETER
AND 1 1-2 DIAMETRAL PITCH

WM. GANSCHOW GEAR WORKS
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Graphite Lubrication.

This is a subject that is now commanding the attention of the engineering profession the world over. It seems to be the only successful method of lubrication where high pressure and superheated steam is used.

Graphite lubrication is equally suitable for all machinery from the smallest to the greatest.

We have a very interesting pamphlet on the subject which is mailed free of charge.

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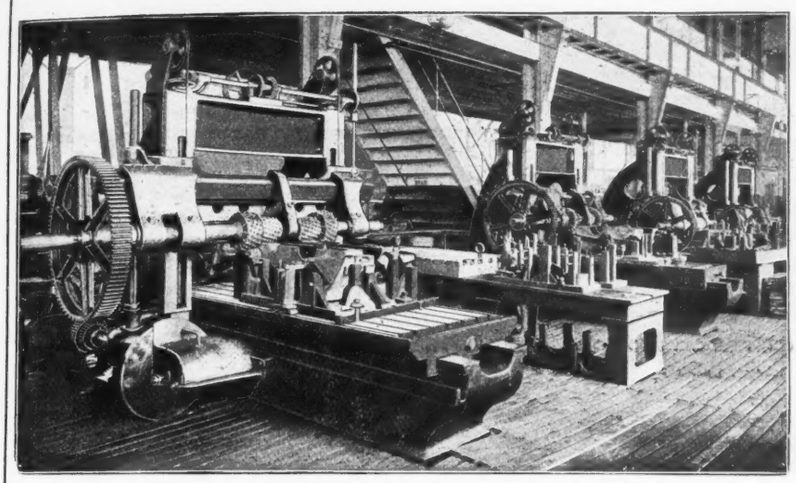
Exclusively.

All sizes: One, Two, Three or Four Spindles.



A group of four of our machines milling cast steel motor frames.

The Ingersoll Milling Machine Co.

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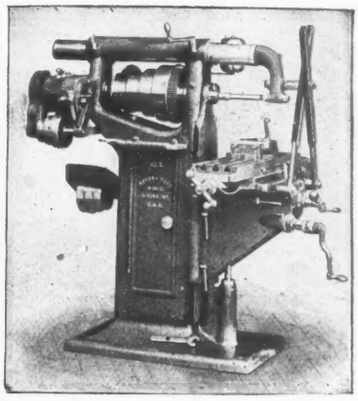
EASTERN BRANCH, 126 LIBERTY STREET, NEW YORK, WALTER H. FOSTER, MANAGER.



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in every respect is what our No. 2 Plain Miller will be found—it is strong, rapid and convenient. May we quote you price?

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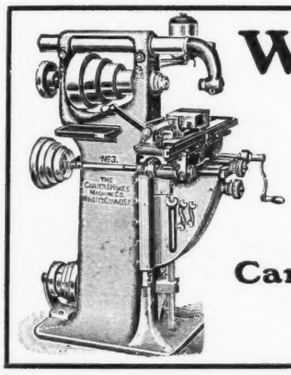
Aurora, Indiana.



We Have Made

An attractive price on this No. 3 Plain Miller, and it is a first-class machine in every particular. Shall we send you circular which gives full description?

Carter & Hakes Machine Co.

Winsted, Conn.

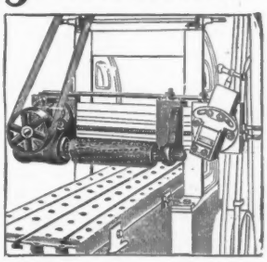
Or Manning, Maxwell & Moore, New York.

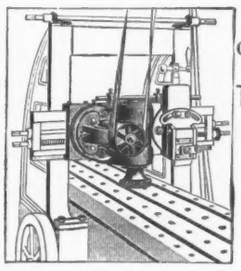
Milling Machine

Combined with any Iron Planer.

Swivels from Horizontal to Vertical.

Milling, boring and planing can be done on a casting at one setting.

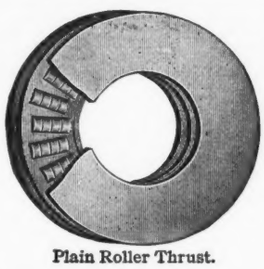




Send for Catalogue No. 55.

THE ADAMS COMPANY,

Dubuque, Iowa.



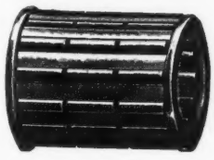
Plain Roller Thrust.

Antifriction Bearings of all Descriptions.

Send for new Catalogue.

Ball Thrust

THE BALL BEARING CO.



Journal Roller Bearing.

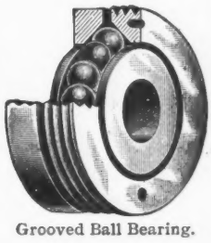
NOTICE OF INFRINGEMENT SUIT

Our products covered by PATENTS owned and controlled by us are being infringed. We hereby GIVE NOTICE that we have ENTERED SUIT against the company that is infringing, and will also SUE USERS of their products.

BALL BEARING CO.

(Formerly of Boston)

2322 MARKET ST., PHILADELPHIA, PA.



Grooved Ball Bearing.

11 Inch Speed Lathe

WITH

Combination Wheel and Lever Tailstock.

SEND FOR CIRCULAR.

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Lunkenheimer Valves are made in endless variety for every requirement, in standard sizes. in bronze and iron, for medium and extra heavy pressures. None but high grade materials and skilled workmanship enter into their makeup. Subjected to rigid test and inspection before shipment. Specify *Lunkenheimer* make and order from your dealer. Write for Catalog.

THE LUNKENHEIMER CO., Cincinnati, Ohio, U. S. A.

Branches: New York, 26 Cortlandt St.; London, 35 Great Dover St., S. E.

4

When you are in need of a **Feed Water Heater** why not purchase the **Best,** when it will cost you no more than a **Poor** one. Send for circular A of the

Otis Tubular Feed Water Heater, Oil Separator and Purifier.

It will interest you as it is **Guaranteed** to heat the feed water to the **Boiling Point** (210° or 212°) with the exhaust steam without causing any back pressure. Also to **Extract the Oil** from the exhaust so that the exhaust steam, after being passed through the heater, can be used for heating purposes and the water of condensation from the heating system be returned to the boilers without the extra expense of an additional **Oil Separator** or **Eliminator.**

We pay all the cost of the trial

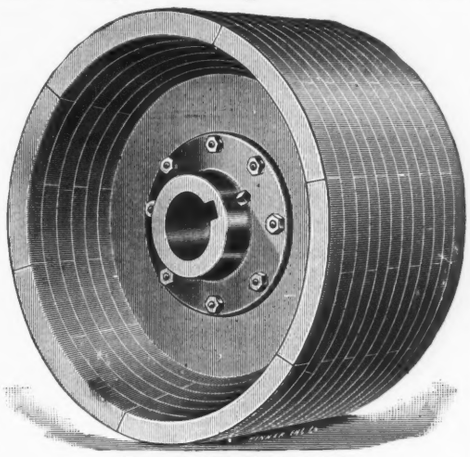
of our Heaters, freight, cartage and all piping, if they fail to do what we claim for them. Send for catalogue and reduced prices to

The Stewart Heater Co.

79-99 East Delevan Avenue, BUFFALO, N. Y.

For Dynamos, Trip Hammers or other Heavy Work.

We manufacture a solid web pulley especially adapted for extremely severe work and guarantee that it will do the work specified, no matter how heavy. Style D. built of selected, thoroughly seasoned maple, having an iron center fitted with key seat and set screw, is the lightest, strongest, stiffest and best finished Dynamo Pulley on the market.



STYLE D. SPECIAL PULLEY.

The Gilbert Wood Split Pulleys are universally acknowledged to be as perfect, both in material and construction, as it is possible to make them, and can be used successfully wherever a belt can be operated. Excel all others in correctness of balance and trueness of running. Write for illustrated catalogue and price list.

Saginaw Manufacturing Company,

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SALES AGENCIES IN ALL THE PRINCIPAL CITIES IN THE WORLD.

NEW YORK BRANCH, 44 Dey Street 'Phone 187 Cortlandt. CHICAGO BRANCH, 35 South Canal Street.
Cable Address, Engrave. A. B. C. and Lieber's Codes

JENKINS BROTHERS VALVES.

Perfectly tight under all pressures of steam, oils or acids.
Warranted to give satisfaction under the worst conditions.

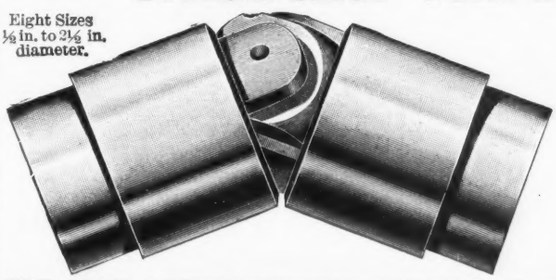
Received the Highest Award GOLD MEDAL at the Pan-American Exposition

Insist on having the genuine, stamped with Trade Mark.

JENKINS BROTHERS, New York, Boston, Philadelphia, Chicago.

THESE ARE THE BEST.

Eight Sizes
⅛ in. to 2½ in. diameter.



If you use Universal Joints these are the best you can get. Sold at the lowest price of any good joint.

Send for prices and Circular "B."

THE GRAY & PRIOR MACHINE COMPANY, Hartford, Conn , U. S A.

OIL HOLES ARE NECESSARY

in machinery and it is reasonable to supply something to protect them.

THE WINKLEY CO.'S

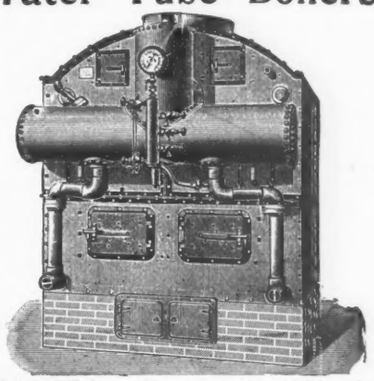
Oil Hole Covers

are the result of much study and leading manufacturers recognize their value. Can you afford to offer machines without them? Samples free. Manufactured by

The WINKLEY CO., Hartford, Conn.

Almy's Patent Sectional

Water Tube Boilers.



Highest Efficiency, Time-proven Durability, Light Weight, Small Space, High Pressure and Perfect Safety. Can be knocked down for Mule Back. For Fire Pumps, we guarantee 70 lbs. steam in 7 minutes

ALMY WATER TUBE BOILER CO.
PROVIDENCE, R. I.

Sellers' Restarting Injector

A strictly first class machine at moderate cost.

Perfectly automatic, has wide range of capacities, and raises water promptly with hot or cold pipes.

Very simple, has few parts and is easily repaired.

All parts interchangeable, made of the best bronze, and the workmanship is perfect. Send for special catalogue descriptive of this Injector.

JENKINS BROTHERS, Selling Agents
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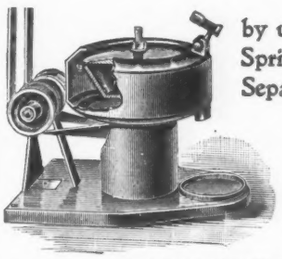

by using the Springfield Separator.

Requires no skilled attendant.

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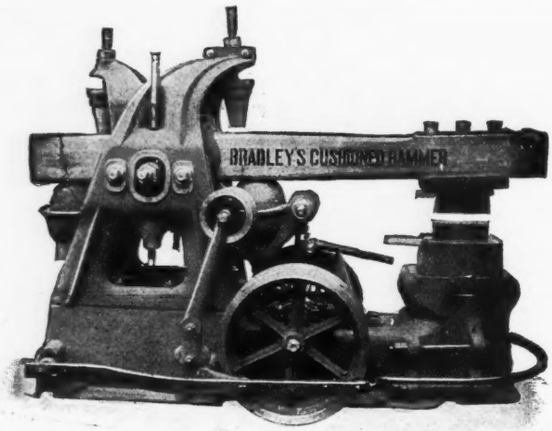

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Cushioned Helve Hammer

Is in a class by itself. There is no other Cushioned Helve Hammer.

If your work is continuous, like plating, drawing, swaging, collaring, welding or spindle making, with infrequent changes in size of material, or

If it is die-work where perfect accuracy and the finest finish are imperative, there is no other Hammer made that can compare with it in quantity and quality of output, durability, controllability or any other feature. Made with heads weighing 15 to 200 lbs.

More Bradley Hammers are sold each year than of all other power Hammers combined. We make four styles of belt Hammers and a line of Heating Forges. Send for circulars.

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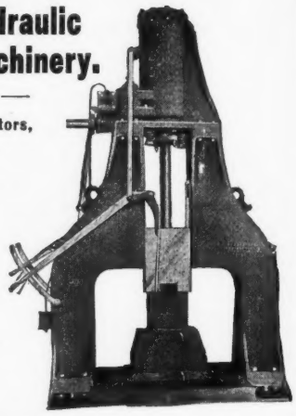
FOREIGN AGENTS—Schuchardt & Schutte, Berlin, Cologne, Vienna, Brussels, Stockholm, St. Petersburg. Buck & Hickman, Whitechapel Road, London. Montgomery & Co., 23 Boulevard Magenta, Paris.

Steam Hammers

AND

Hydraulic Machinery.

Accumulators,
Riveters,
Cranes,
Presses.



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HAMMERS of all sizes and for all classes of work. Double and single frame. Made with **STEEL FRAMES** for severe service.

Chambersburg Engineering Co.,
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POWER HAMMERS,

SCRANTON & CO.,
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1. Occupies less space.
2. Requires less power.
3. Is simpler in construction.
4. Works stock of greater extremes in size.
5. Strikes a truer and firmer blow than any other hammer made with same weight of ram.

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Beaudry

POWER

Is the Best.

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HAMMER

12 SIZES.

Adapted for Every Class of Work.

8 Oliver Street,
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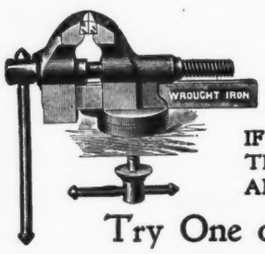

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Try One of These!

MERRILL BROS.,

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DROP PRESSES

For All Purposes Our Specialty.

MINER & PECK MANUFACTURING CO.,

PROPRIETORS OF

The Peck Drop Press Works, New Haven, Conn.

BENNETT HANDY OILER.

SELF-CLOSING.

Meets every requirement for a device of this kind. Neat, convenient, and easily applied. Made in seven sizes, varying by 1-16 in. from ¼ in. to ⅝ in. Patented July 23, 1901. Samples free. Send for discount. **BAY STATE STAMPING CO.**, 21 Hermon St., Worcester, Mass.

European Agents, Chas. Churchill & Co., London, England.

A Money Saver for your Drill Press

The **Graham Universal Jig Vise** will save time and money on drilling interchangeable work.

Can be used on any drill press. As easily adjusted as an ordinary vise.

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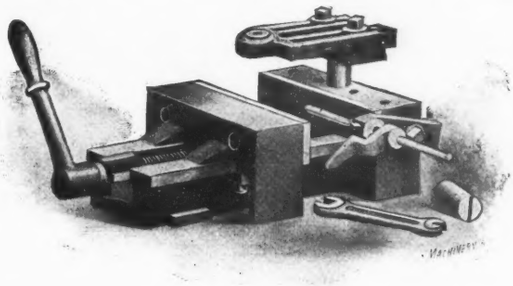

Made in Three Sizes.

No. 3—Jaws 6″ long, 1½″ deep, can be opened 4½″. Price, $20.00.

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Sent on Trial.

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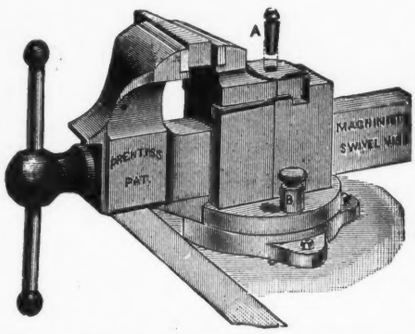

Machinists' Swivel Vise

with self-adjusting jaw that is as strong and durable as any solid jaw, and a Swivel Bottom that gives any desired adjustment to right or left, and is solid and firm at any angle. We make all sorts of good vises, and have been leaders in this line for twenty years. Send for catalogue and price list,

Prentiss Vise Company,
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METAL POLISH

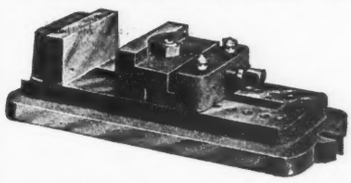
that works quick and keeps its lustre. Holds old trade and makes new. Does not deteriorate. Established 16 years.

3-oz. Box for 10 cents.

Sold by Agents and Dealers all over the world. Ask or **write for FREE** samples.

GEO. W. HOFFMAN,
Expert Polish Maker,
Indianapolis, Indiana.

Time and Drills are Both Worth Saving

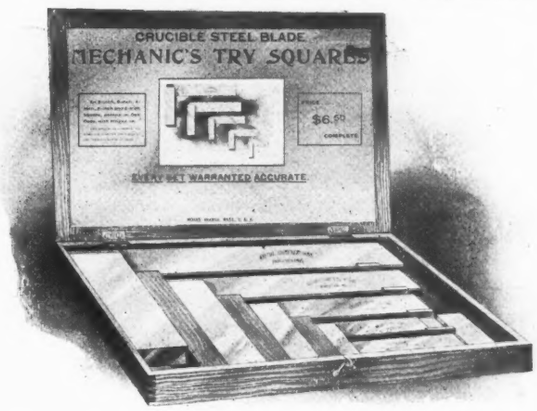


And we have a little device that will save both. If you don't know about the Hopkinson Drill Vise already let us send you particulars. A vise built specially for holding work in the upright drill.

HOPKINSON MACHINE COMPANY SPRINGFIELD, MASS.

Try Turner's Try Squares

And you will buy no others.



Sets of five Squares in Oak Case, $6.50.

Single Squares,
2″, 75cts.
3″, $1.00.
4″, $1.25.
6″, $1.50
8″, $2.00.
10″, $2.50.
12″, $3 00.
15″, $3.50.

24″ and 36″ Squares not yet ready.

These squares are superior in accuracy, workmanship and wearing qualities to any other tools of their class.

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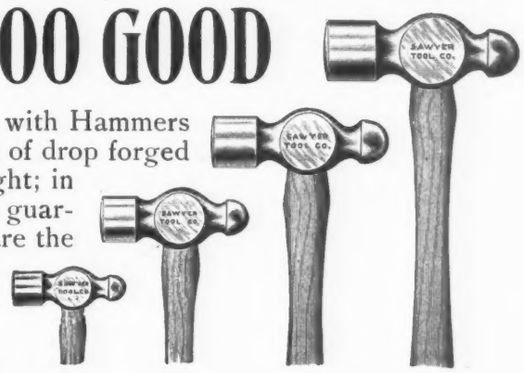
SHOP AGENTS WANTED.

THE BEST IS NONE TOO GOOD

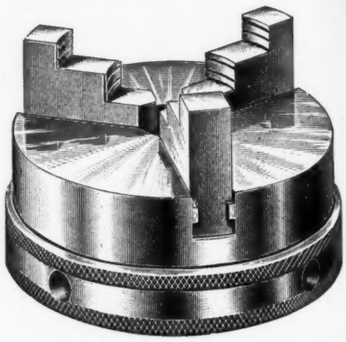


in the Hammer line. We are furnishing you with Hammers beautifully finished, made from the best grade of drop forged tool steel, hardened just right and hung just right; in fact we guarantee them to please you, as well as guaranteeing them not to break or chip. They are the best Hammer made. Get our catalogue E 7 describing all our tools; it will pay you to do so and cost you nothing.

SAWYER TOOL MFG CO., FITCHBURG, MASS., U. S. A.

Do You Use Scroll Chucks?

If so, you can save money by dealing direct with us. Mr. E. L. Dean, Model and Pattern Maker, Holyoke, Mass., ordered a 6 in. Dexter Scroll Chuck saying he had one of our 3 in. chucks in use for nearly two years on a high speed pattern lathe and liked it very much. Send for price list.



The Leavitt Machine Co.
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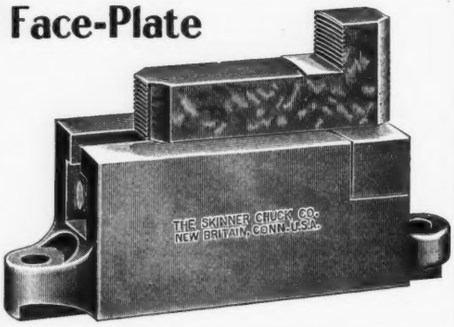
Skinner Reversible Face-Plate Jaws. Made in five sizes.

6″, 8″, 10″, 12″ and 14″.

1902 Catalogue now ready.
You can have a copy for the asking.



The Skinner Chuck Co.,
New Britain, Conn., U.S.A.
New York Office, 94 Reade St.

It will grip on any caliper or 3/16 in. rod. Five Tools in one; very handy for laying out work.

OUR **Caliper Attachment**

Is indispensable to **Machinists and Draftsmen.**

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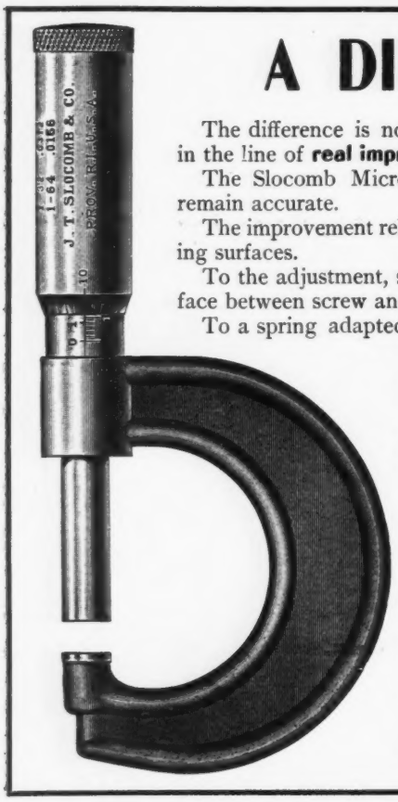
247 Lake St.,
MILWAUKEE, WIS., U. S. A.



A DIFFERENCE.

The difference is not merely for the sake of difference but in the line of **real improvement.**

The Slocomb Micrometer is made to stand long use and remain accurate.

The improvement relates to the size and nature of the wearing surfaces.

To the adjustment, so that the same area of wearing surface between screw and nut **can be maintained.**

To a spring adapted to produce a slight uniform friction between screw and nut so it is **never loose at any point,** and will not move around of its own accord.

Incidently this spring keeps the spindle back and allows of using a better running fit.

Allows of good lubrication and avoids nine-tenths of the danger of roughing up and sticking.

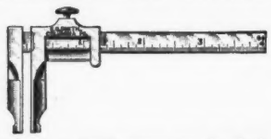
Did you ever "catch on" to all the good points of a Slocomb Micrometer?

Better drop us a postal card to-day and receive our catalog.

We make 13 sizes measuring from 0 to 12 in. and many varieties.

J. T. Slocomb & Co., Providence, Rhode Island.
Chas. Churchill & Co., London, England.

"A 'LEETLE' UNDER AN INCH"



Or "just a hair over an inch" may have answered for 50 years ago. But it isn't the way measurements are given nowadays. An inch is an inch and you want an instrument that will measure and measure right.

The "Columbia" Caliper stops all guessing.

Put it over the work and you know in an instant what size the piece is.

4 inch No. 1 Caliper graduated in 16ths and 64ths, hardened jaws 1¼ inch long—by mail $1.60 net.

Write for booklet and discounts.

E. G. SMITH, Columbia, Pa.

BOWSHER'S PATENT BALANCING WAY

is the best way to get things on the level in a hurry. You get an **ABSOLUTE LEVEL** in ten seconds; as against ten or twenty minutes the old way for uncertain result. Three sizes and styles; for bench and floor use.

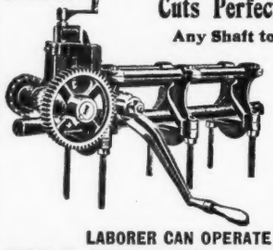
ALL MONEY SAVERS FROM THE WORD GO.

Ways chilled and ground. Spirit levels attached.

Ask for Circular "BW."

THE N. P. BOWSHER CO. SOUTH BEND, IND.

BURR PORTABLE KEYSEATER.
Cuts Perfect Keyseats.
Any Shaft to 5 in. Dia.



NEEDN'T TAKE SHAFT DOWN
SELF-CENTERING
AUTOMATIC FEED.
QUICK RETURN.

LABORER CAN OPERATE IT.

JOHN T. BURR & SON, 34 South 6th St., BROOKLYN, N. Y.
Selig, Sonnenthal & Co., London.

The National Chucks

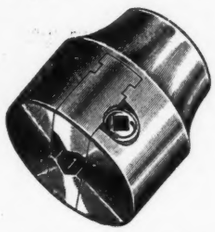
are guaranteed for accuracy, workmanship, and quality of material used. Strong, efficient, durable.
Write for prices and catalog.

Oneida National Chuck Company,
Oneida, N. Y.
Manufacturers of the "National" complete line of Chucks.

No Weak Places

IN THE

Reid Drill Chuck



One part is as strong as another. Outwears any other kind of chuck. Made right and sold at the right price. Circulars and price lists mailed on request.

R. H. BROWN & CO.,
New Haven, Conn.

If you want the best Lathe and Drill

CHUCKS

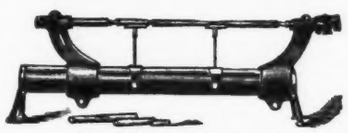
BUY WEST-COTT'S.

Strongest Grip, Greatest Capacity and Durability, Cheap and Accurate.
WESTCOTT CHUCK CO., Oneida, N. Y., U. S. A.
Ask for catalogue in English, French, Spanish or German.
FIRST PRIZE AT COLUMBIAN EXPOSITION, 1893.

Almond Drill Chuck.

Sold at all machinists' supply stores.

T. R. ALMOND, 83-85 Washington Street, Brooklyn, N. Y.



(Style of 12 and 24 sizes.)

Measuring Machines.

Measuring screw, 10, 16 or 20 threads to the inch, graduated to read thousandths or 32ds without calculation.

The only Micrometer that will not lose its accuracy by wear.

SYRACUSE TWIST DRILL CO., SYRACUSE, N. Y.
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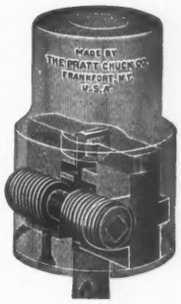
The Machinists' Ideal, • A Chuck in which a Drill Cannot Slip.

THE PRATT
Positive Driving Drill Chuck

is built to meet this requirement, and it does perfect work. A drill cannot slip in a Pratt Chuck. The patented equalizing driver prevents slipping. The drill can also be used up to the full capacity without either slipping or scoring the shank. Ask for our descriptive booklet.



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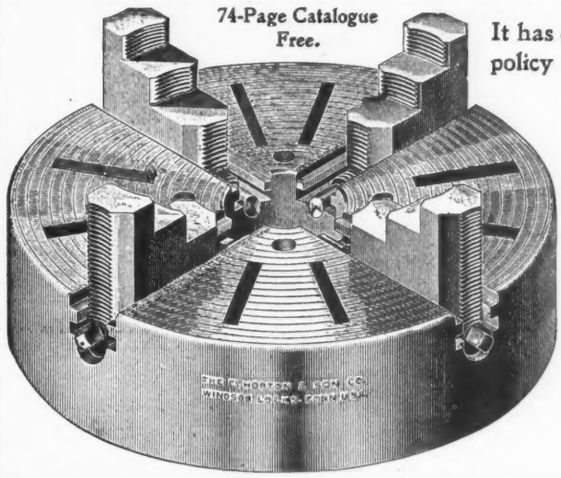

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to have all the facilities for doing good work; and not to spare time, machinery, material or other expense to accomplish that end. Our experience in making

CHUCKS

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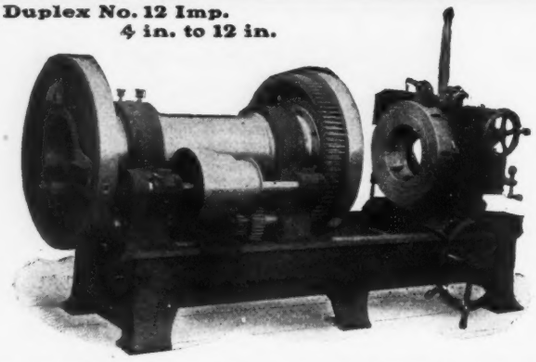

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Has performed only a part of the work it should do when it has cut off the pipe and chased the threads. The machine is necessary for this work, but it will save a great deal of labor, time and money if it can be used for making up the work.

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As nearly perfect as can be made

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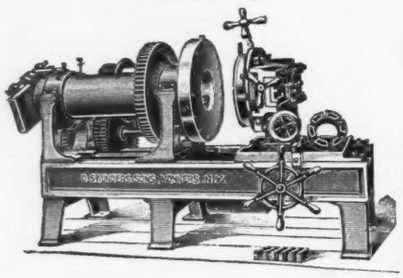

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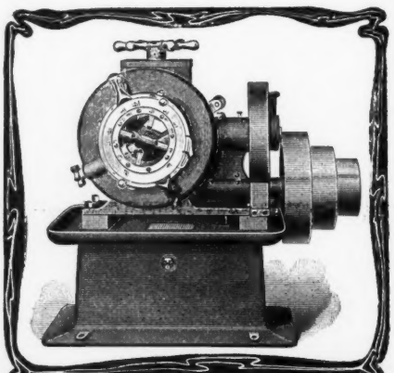

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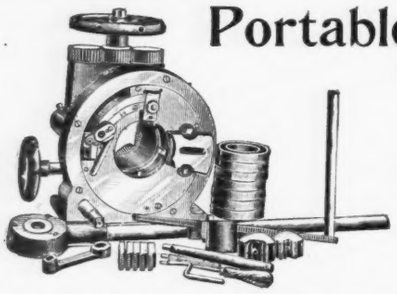

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For Cutting and Threading Pipe

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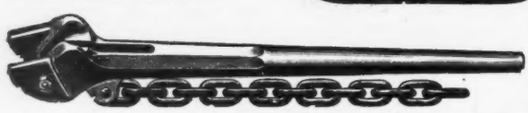

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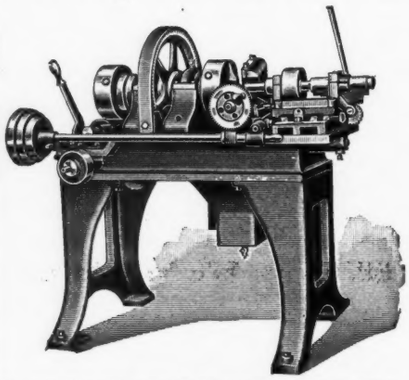

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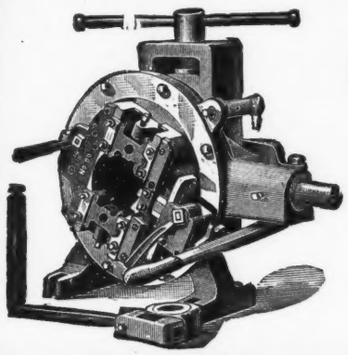

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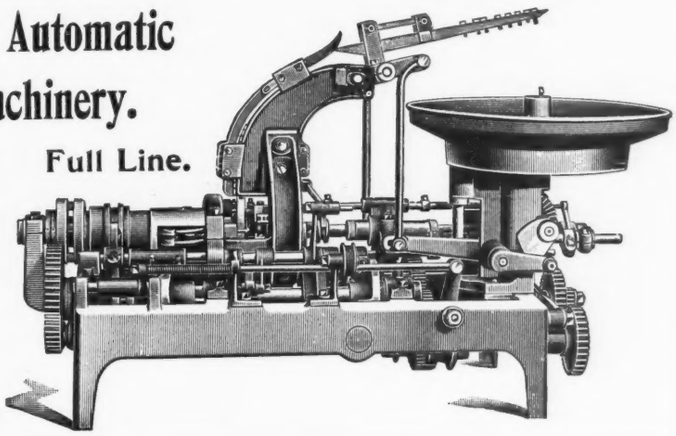

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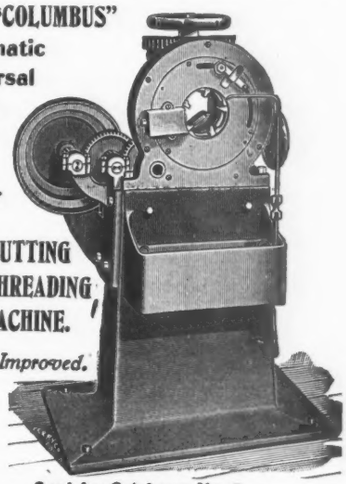

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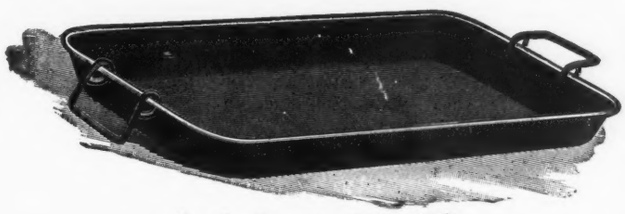

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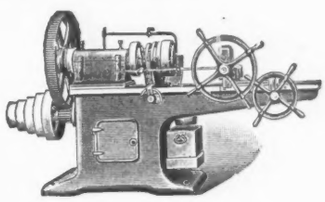

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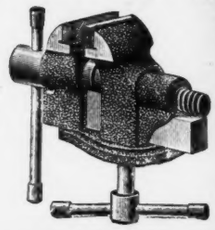

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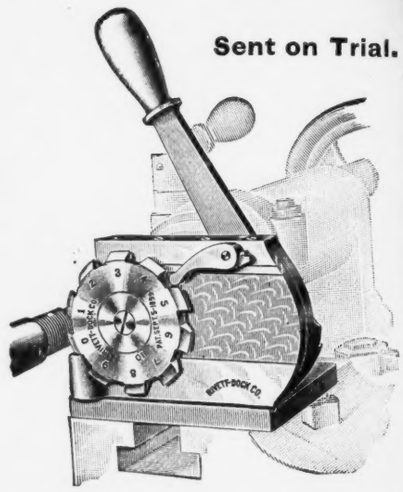

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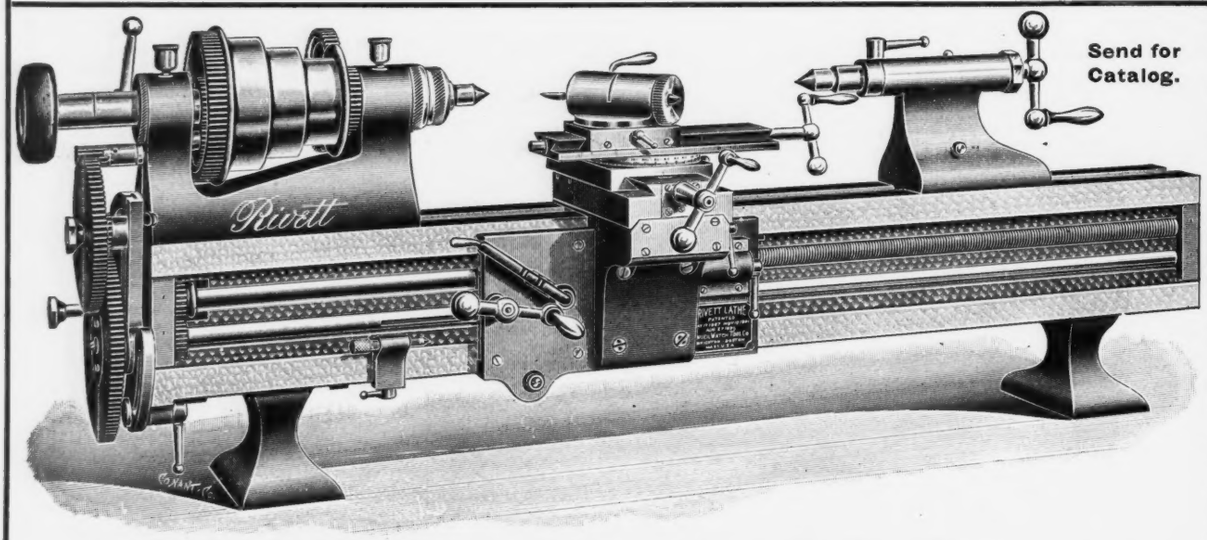

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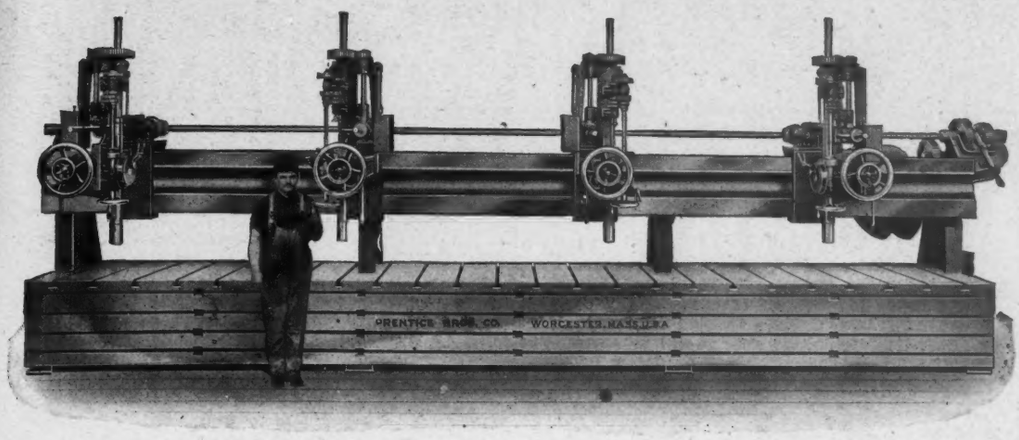

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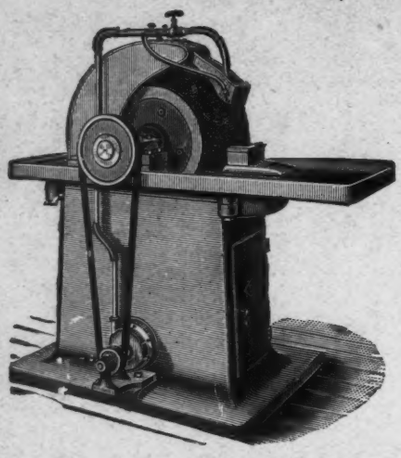

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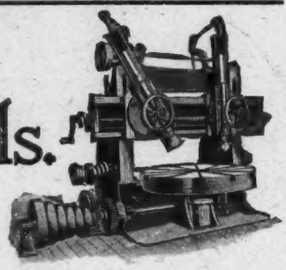

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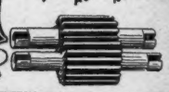

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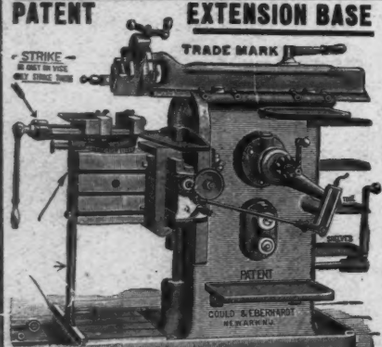

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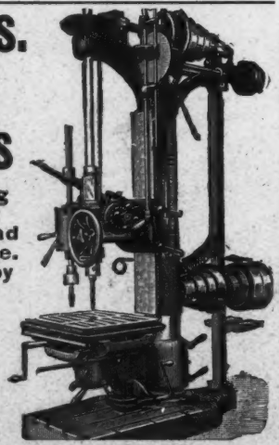

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